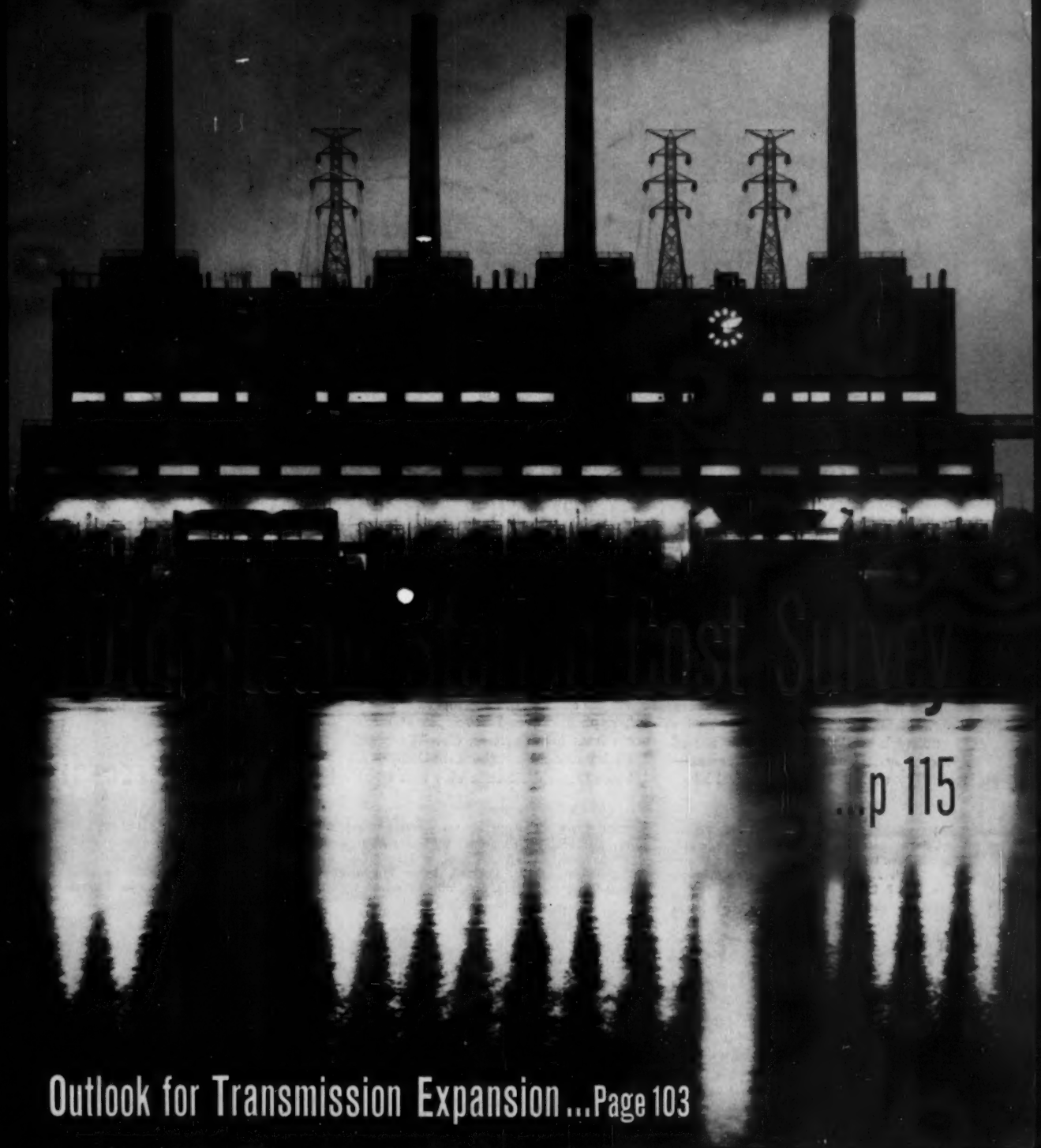
The Electrical Industry's Weekly Magazine

October 7, 1957

Electrical World

A McGraw-Hill Publication



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Outlook for Transmission Expansion ... Page 103

TRANSIENT NETWORK ANALYZER supplies data for a joint G.E.—American Gas & Electric Co. study of transmission tower lightning flashovers on a 345-kv line. L. to r., W. S. Price, AG&E Service Corp., G.E.'s J. G. Anderson, High Voltage Lab., and W. F. Skeats, Switchgear Development Laboratory.

How General Electric is helping 50 utilities conserve engineering manhours this year

By providing computational equipment and associated engineering assistance, General Electric is helping approximately 50 electric utilities solve individual system problems during 1957. Thus, these utilities—representing over one-third of the nation's generating capacity—are accomplishing more per engineering manhour.

This service originated over 40 years ago, when General Electric first offered a d-c network analyzer—the forerunner of modern system-analyzing equipment—for utility use. Since then, General Electric has led in the development of analytical tools and techniques for investigating utility systems.

Through the years, the growing facilities in Schenectady have been applied to study virtually every type of utility problem. As a vital aid to utilities in setting up such studies, General Electric offers the services of experienced analytical, application, and development engineers from headquarters, district offices, and laboratories throughout the Company.

Since General Electric also uses these computational tools to further improvements in basic system engineering concepts, the entire electric utility industry benefits from their use. For more information on how these General Electric facilities can help save engineering manhours for you, contact your local General Electric Apparatus Sales Office. General Electric Company, Section 301-362, Schenectady 5, N. Y.

MORE POWER TO AMERICA

GENERAL ELECTRIC

A-C NETWORK ANALYZER helps Florida Power Corp. determine future construction requirements for its system. L. to r., M. F. Hebb, Florida Power Corp., G.E.'s J. C. Hartley, Atlanta Application Engrg., and R. D. Wood, Analytical Engrg.

ELECTRONIC COMPUTER quickly solves utility power loss problem conducted by G.E.'s A. J. Glimn (center), Analytical Engrg., and Ruth E. Callaghan and H. N. Cantrell, Large Steam Turbine-Generator Engrg. Calculations Center.

ELECTRONIC DIFFERENTIAL ANALYZER is employed by F. S. Rothe (left), Analytical Engrg., and M. Temoshok, Engrg. Planning and Development, to calculate data leading to improved excitation systems in generators for utilities.

Electrical World

Vol. 148, No. 15 October 7, 1957

Published for 83 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

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Holding company's stations again rank highest on FPC net heat rate. Tanners Creek first with 9,106 Btu.....p 100

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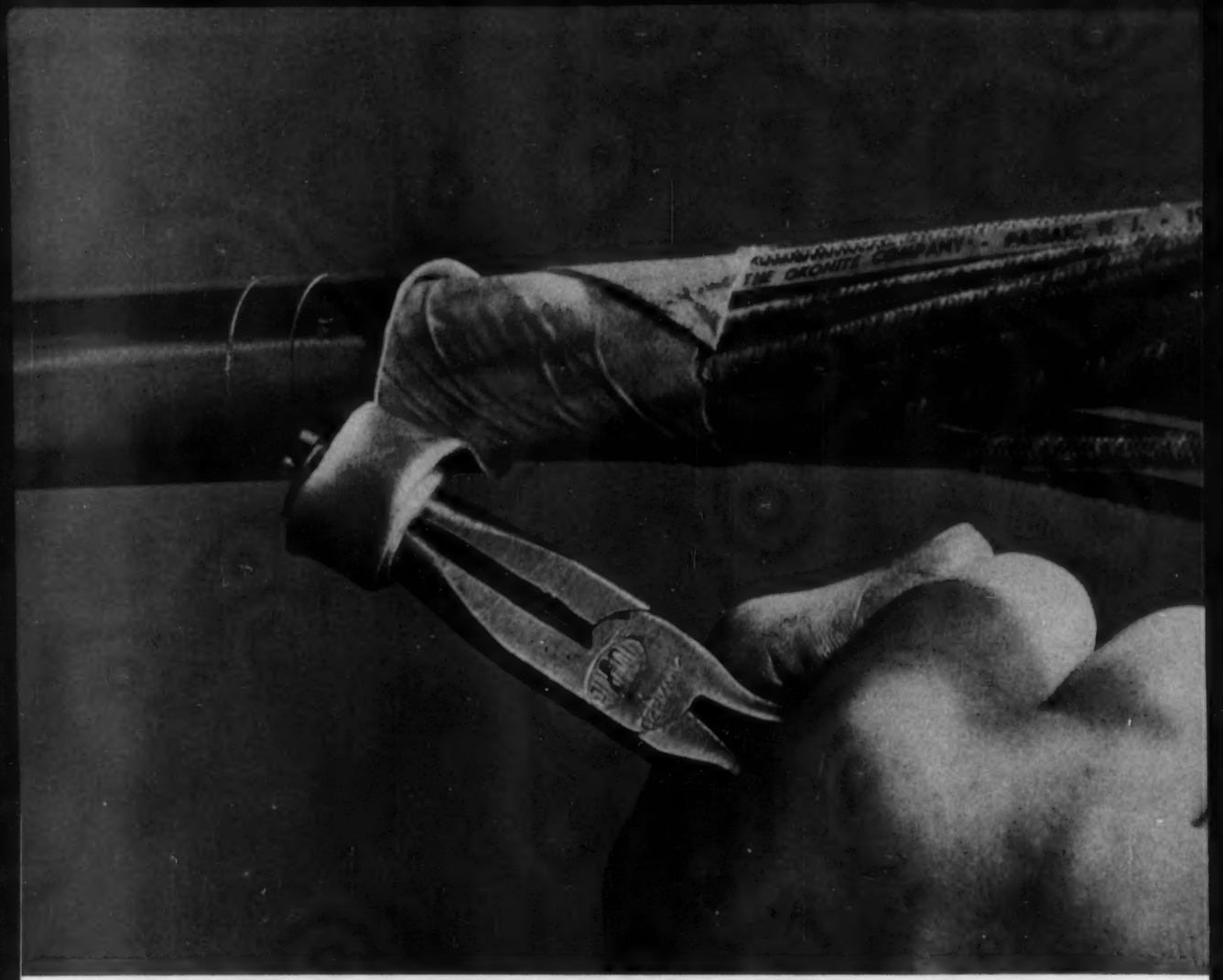

ALUMINUM-SHEATHED CABLES

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A seamless aluminum sheath over Okonite cables provides a durable, conduit-type covering of high tensile strength. Yet this aluminum sheath is easily worked with standard conduit tools. It can be bent around obstructions . . . terminated at boxes, transformers, and the like . . . trained in trays . . . or supported by conventional brackets and cable clamps. Standard fittings are available. This low-cost alternate to rigid conduit is available with virtually any Okonite insulation such as rubber, plastic or varnished cambric.

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More For Your Reading Time

We know you're a busy man. Because you're already at page 5 of your weekly magazine, we know you're searching for ideas and information that will aid you in your job.

To help you, we try to make Electrical World an easy-to-read, quick-to-convey magazine. During the next few weeks we'd like to share with you a few tips for getting more out of each reading minute. Here we go:

Tip No. 1—Take a first, fast look. Run down the contents page for guidance (it's always on page 3). Thumb through to the first yellow pages. A minute or two on the News-Scope page gives you the cream of the late and future news. Two minutes on the Electrical Week pages will give you further guideposts for the issue. A minute or so on the Engineering Trends page gives you a look-ahead in the technical field.

As you leaf through the issue you'll spot ads and articles you'll want to read right away. Make a mental note or use some kind of bookmark for others you want to come back to.

The important thing is: Do your first reading now. Don't wait for the mood.

Fischer Black

ELECTRICAL WORLD

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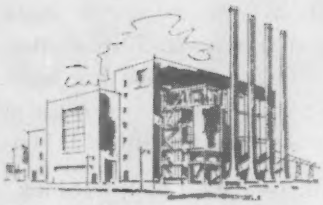
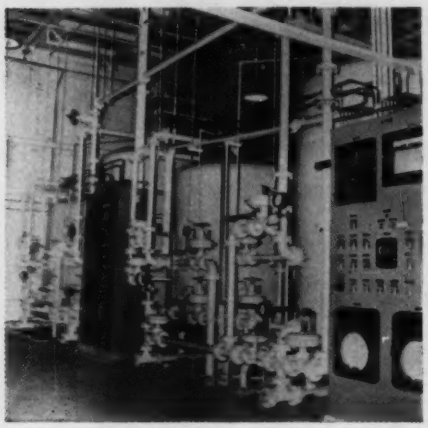
First in water conditioning



Installation below is a large paper mill. It provides an effluent with silica content below 0.02 ppm and total dissolved solids below 1.0 ppm. Total capacity 100,000 lbs/hr. for 1200 psi boiler.



Cochrane DEMINERALIZERS

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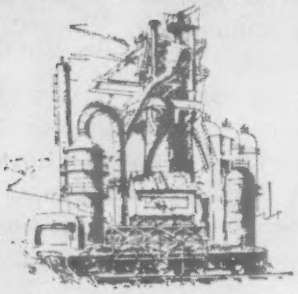

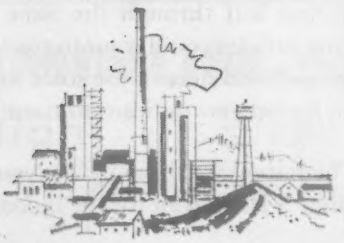

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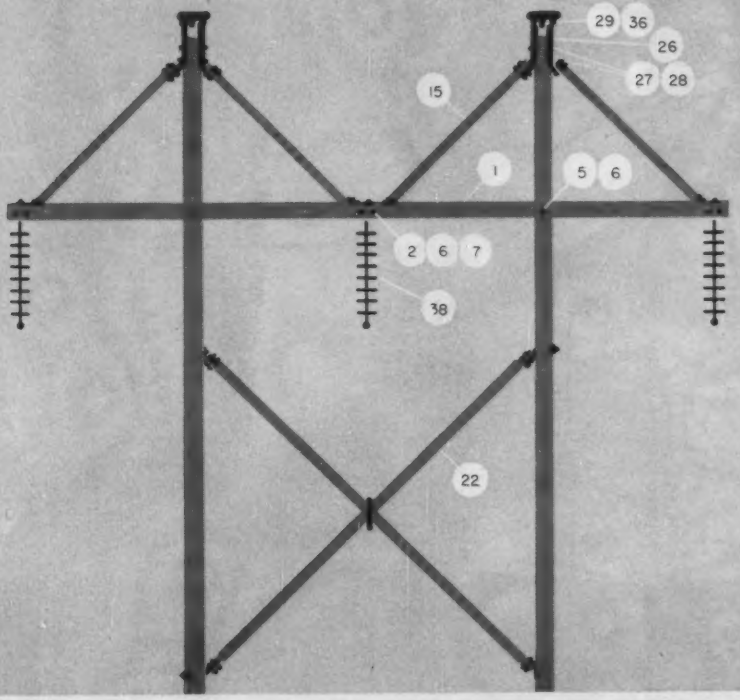
DRG. REF. #	QUANTITY	DESCRIPTION	DRG. REF. #	QUANTITY	DESCRIPTION
792	2	Pole	15	4	Vee brace 3⅜" x 4⅜" cross section
1	2	Crossarm	22	1 set	Cross brace w/fittings, clamp, ⅞" pole bolts and curved washers
2	3	Steel spacer fitting w/mounting bolts	26	2	Static wire support
5	2	Stud bolt ⅞" w/washer nuts	27	4	Machine bolt ¾"
6	8	MF locknut ⅞"	28	4	MF locknut ¾"
7	1	Bent stud bolt ⅞" x 8" w/2 sq. nuts	29	2	Clevis
7	2	Bent bolt ⅞" x 5½" w/sq. nut	36	2	Suspension clamp for static wire
			38	As required	Suspension insulators and fittings



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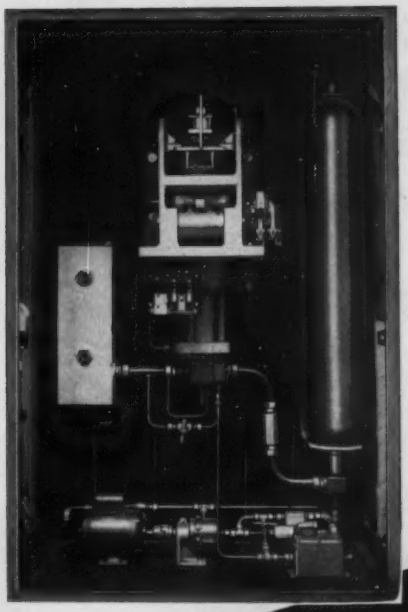

story of acceptance!

Although the pneumatic operator is still available, the *Pneu-Draulic* operator has virtually supplanted it on Allis-Chalmers outdoor breakers rated 14.4 kv, 500 mva and larger.

In fact, over 90 different power systems are now using breakers with the *Pneu-Draulic* operator, and 49 have placed repeat orders. All this in only 3 years!

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A-5479

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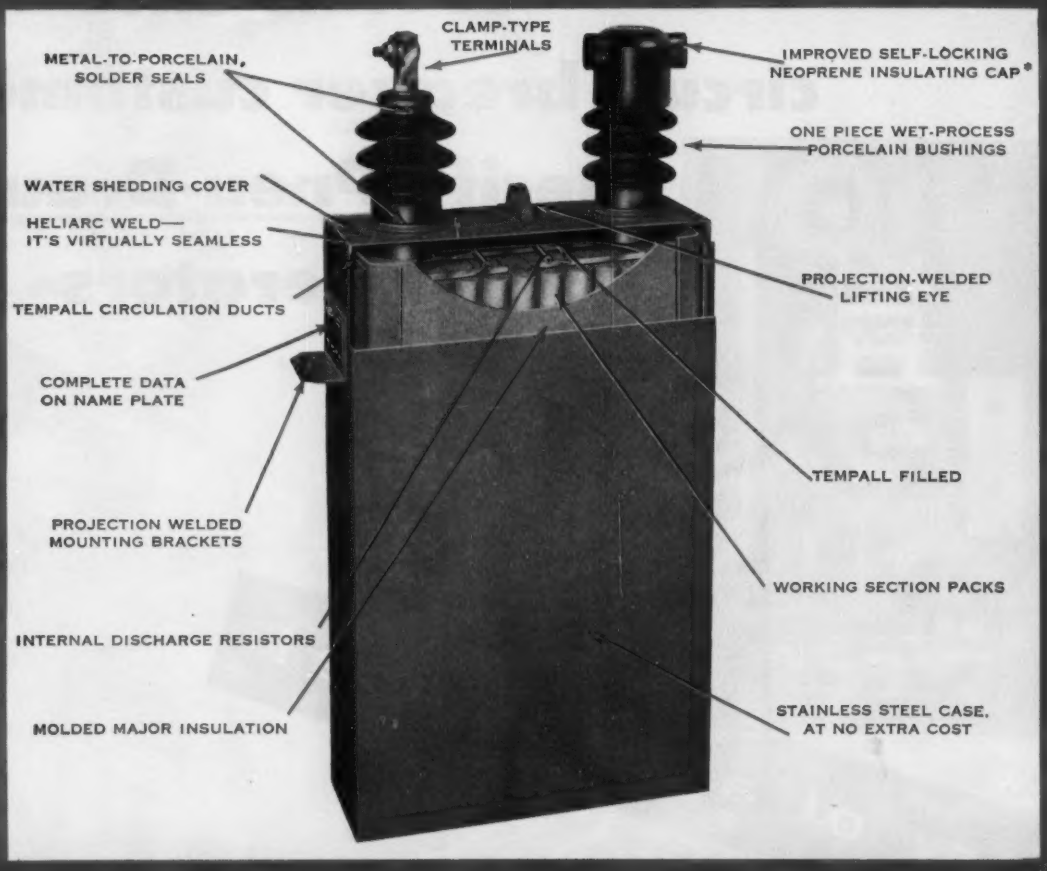
Pneu-Draulic is an Allis-Chalmers trademark.

TOBE invites you to look inside the capacitors...



BEFORE YOU BUY A HOUSE, you look a lot farther than the color of the bathroom tile. You find out how the house is really constructed!

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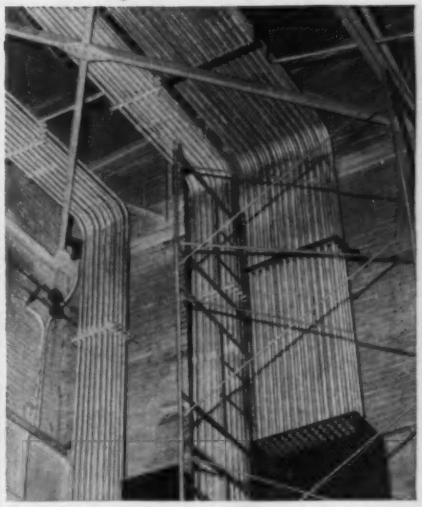

20 YEARS OF DEPENDABLE SERVICE! That's why Iowa-Illinois Gas and Electric Company again specified Republic ELECTRUNITE E.M.T. for its new 69-kv substation at the Moline Generating Station. They and many other utilities appreciate its low initial cost and ease of installation.

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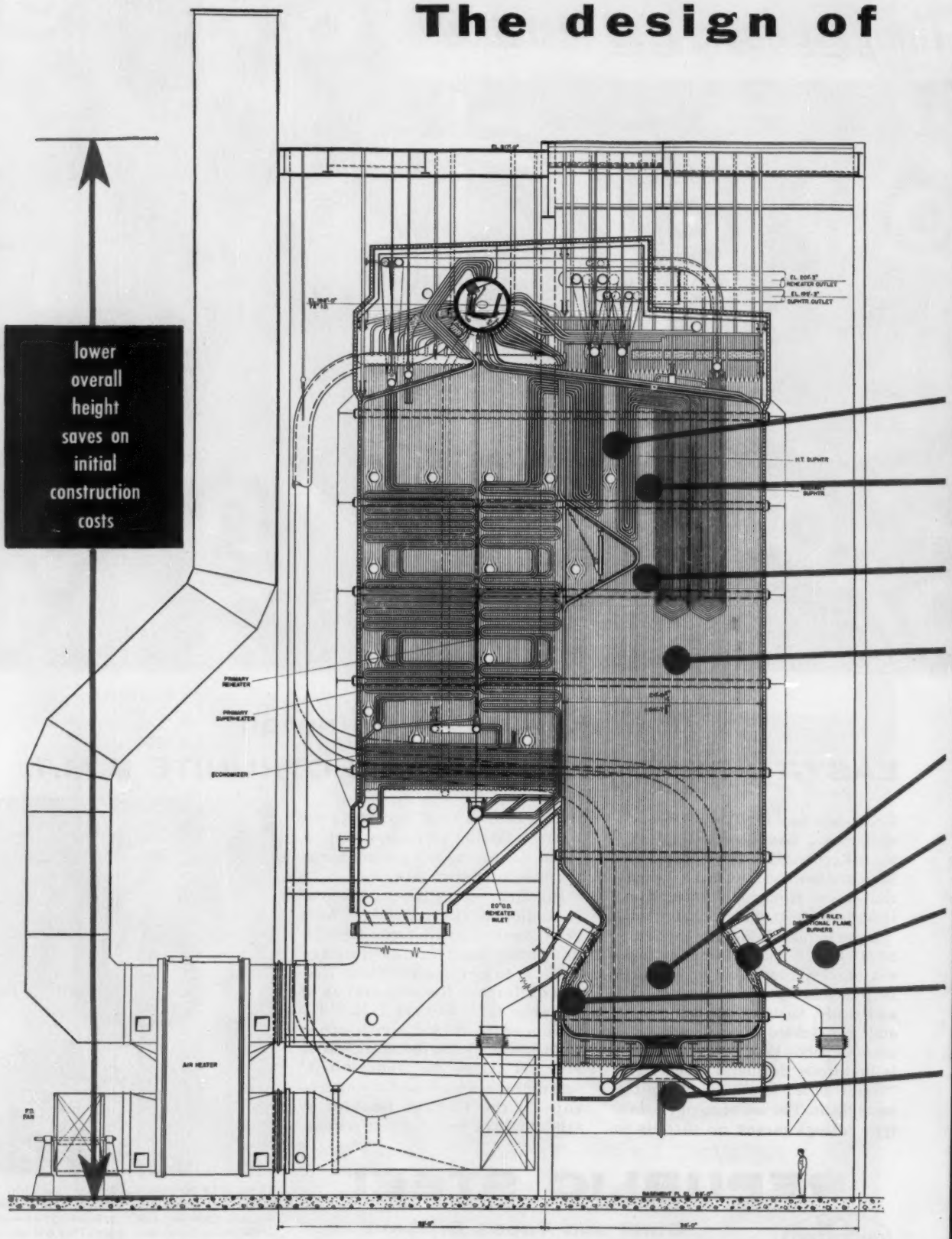

the future that's HERE!

the RILEY TURBO FURNACE

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The unit illustrated is being built at Sterlington Station for Louisiana Power & Light Company. Steam capacity—1,600,000 lbs./hr.—2125 psig, 1005 F. Reheat. Fuel will be gas and oil initially. Pulverized coal, fluid coke or lignite can be fired at anytime in the future.

The Riley TURBO FURNACE Boiler Design has enjoyed a remarkable acceptance since it was first introduced late in 1954. Because of its versatility it has been incorporated into boiler capacities from 150,000 up, reheat or non-reheat, pressurized and non-pressurized. The TURBO FURNACE has been purchased to satisfy numerous operating requirements: to be able to fire multiple fuels, for quick low cost conversion from gas or oil to coal or other solid fuels, to burn fluid coke as a major fuel, to eliminate slagging and slag blowers, to refire flyash and thus eliminate flyash disposal. Twenty TURBO FURNACE units have been sold for industrial and central station installations totalling over ten million pounds of steam per hour. It will pay you to investigate to get the full story on the extra dividends possible in a TURBO FURNACE unit.

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2. FULL CONTROL LINE

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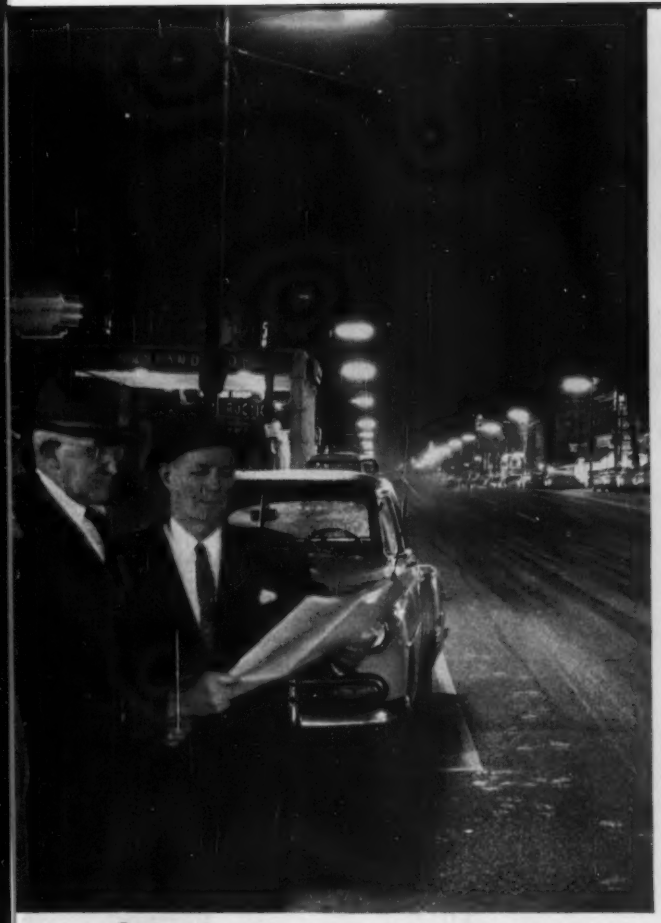
Experienced General Electric outdoor lighting specialists are located in every major city. Backing these field specialists are more career lighting men at the Hendersonville, N. C., plant. The talents of both groups are available to you at all times.



3. START-TO-FINISH APPLICATION HELP

4. RESEARCH LEADERSHIP

vision-engineered street lighting systems

Benefit from the years of street lighting experience General Electric has gained since Thomas Edison lighted the street in front of his home in 1879! Put this know-how to work devising the best means to bring greater visibility to your city's streets!

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new sites placed in operation since
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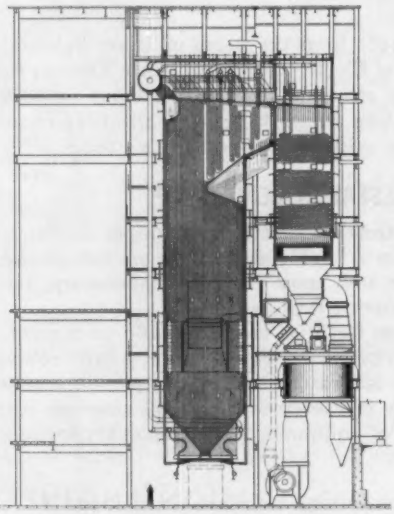
GULF COAST

New Gulf Coast Steam Plant

GOES INTO SERVICE

The C-E Unit shown at the right is now in service at the Gulf Coast Steam Plant. It is of the radiant-reheat type with a reheater section located between the primary and secondary superheater surfaces. An economizer section is located below the rear superheater section and regenerative type air heaters follow the economizer surface. This unit is designed to supply steam at a throttle pressure of 1800 psig with a primary steam temperature of 1000 F, reheated to 1000 F. It is fired by natural gas using tilting, tangential burners.



Mississippi Power Company made a substantial addition to their system recently when Unit No. 1 of their new Gulf Coast Plant was placed in service.

Located midway between Gulfport and Biloxi about three miles above the Gulf of Mexico, this fine new plant extends the system to meet growing demands for service, both industrial and residential, in the Gulf area.

Added to their present stations, Plant Eaton at Hattiesburg and Plant Sweatt at Meridian, the Gulf Coast Plant raises the combined system capacity to about 225,000 kilowatts.

Steam for the new 75,000 KW turbine-generator at Gulf Coast is supplied by a C-E Steam Generating Unit, a cross sectional elevation and brief description of which appear on the opposite page.

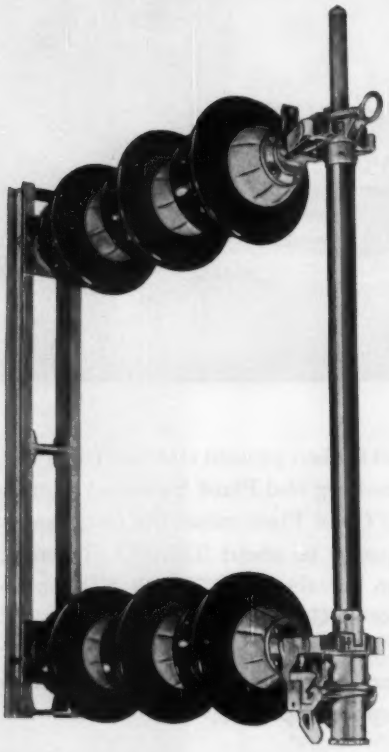
COMBUSTION ENGINEERING

Combustion Engineering Building · 200 Madison Avenue, New York 16, N.Y.

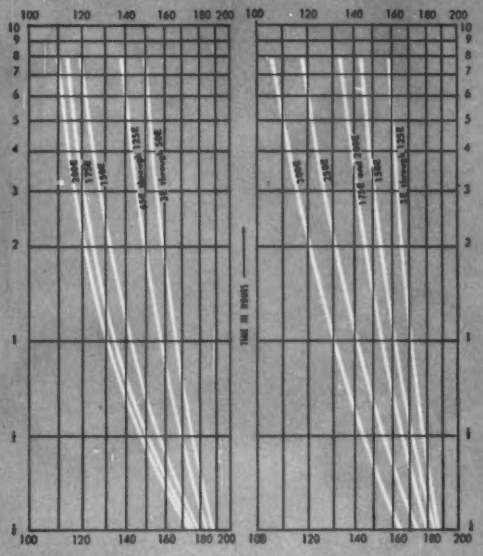
C-124

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

now... even for overloads you can match power fuses to power transformers



short-time emergency overload capability for SMD Power Fuses



Load Current in Per Cent of SMD-1 Fuse Unit Ampere Rating

Load Current in Per Cent of SMD-2 Fuse Unit Ampere Rating

The pressure is on to obtain maximum utilization of power transformer capacity. This pressure has led to precise evaluation of transformer short-time overload capabilities—for both daily peaks and occasional emergencies.

To keep pace, S&C has made correspondingly precise evaluations of the overload capabilities of its power fuses.

The result: (1) New fusing tables (minimum ampere rating recommendation) which recognize short-time daily overload and (2) new curves (see above) which permit you to subject power fuses to extreme short-time overload during emergencies, as when one transformer picks up the load of another.

All of this is part of a new method for power fuse selection contained in a 16-page package—Data Bulletin 262. For your copy, write to S&C Electric Company, 4421 Ravenswood Ave., Chicago 40, Ill. In Canada: S&C Electric Canada, Ltd., 8 Vansco Road, Toronto 14, Ontario.

S&C ELECTRIC COMPANY

NEWS-SCOPE

FUTURE NEWS ▶ **Shippingport's nuclear power plant will go into commercial operation next year.** Reactor should go critical this year but delay in non-nuclear equipment delivery and labor trouble will probably prevent plant's complete startup in 1957.

Washington sources say Ralph Gardner may be the White House choice for the TVA board vacancy. Gardner, North Carolina and Washington lawyer, said he'd seriously consider an offer if it is made.

LATE NEWS ▶ **TVA announces plans for a unit with a 500-Mw nameplate rating.** The unit, largest on order in the U. S. and probably in the world, is tentatively scheduled as a 1960 addition to TVA's Widow's Creek plant. Steam conditions will be 2,400 psi/1,050F with single reheat to 1,000F. Turbine-generator will be a cross-compound unit with 3,600-rpm and 1,800-rpm shafts. Combustion Engineering, quoting on a controlled circulation boiler, was low bidder on the steam generator at $11.96 million. General Electric submitted low bid of $16.11 million for the turbine-generator. TVA sources say the unit will be financed from power revenues at the start.

Southern governors agree to push legislation which would allow utilities to own a part interest in a nuclear generating company without violating the Public Utility Holding Co Act.

Ontario Hydro claims a "world first" in the development and cooling of underground power cables. City tap water is circulated in polyethylene pipes running alongside twelve 115-kv cables to keep line temperatures below 85 C. Insulating oil flows through the center of each cable to act as a coolant and to keep out water.

AEC receives 31 proposals for the design of a gas-cooled, natural uranium 40,000-kw power reactor. Project, which AEC was instructed to study by Congress, is similar to the Calder Hall type.

Sangamo Electric drops prices on power capacitor units from 28% to 41% discount of published list prices, effective Sept. 29. Firm made reduction "in effort to stabilize power capacitor prices."

English Electric Co, Toronto, is apparent low bidder to supply twelve 28,000-hp pump turbines for the Tuscarora plant of the Niagara project. New York Power Authority engineers are now evaluating the bids. Others came from Baldwin-Lima-Hamilton and jointly from Allis-Chalmers and S. Morgan Smith Co.

Congratulations . . . Potomic Electric Power elects L. W. Cadwallader vice president-mechanical engineer; C. L. Carr, VP-controller; D. F. Hughes, VP-electrical engineer; and G. C. McCabe, VP-manager electric system . . . General Electric ups Robert Paxton to executive VP-operations; A. F. Vinson to VP and group executive-apparatus; J. H. Goss to VP and group executive-consumer products; and H. B. Miller to VP-manufacturing services.

STEAM STATIONS ▶ **Costs are up for power generation.** EW's current Steam Station Cost Survey compares today's expenses with those of previous years. At the busbar, power averages about 7 mills per net kwhr, but four stations produced electricity at less than 3 mills. No smooth trend curve could be developed to show decreasing energy costs with an increase in station size (p 116).

Building costs have jumped, too. About 50% of the reporting companies said building costs were $136 or less per kw now (as compared with $129 in 1954). This is a 5½% hike. Average station cost hit $146 per kw, with outdoor plants being cheaper than indoor, and gas or oil-fired plants being cheaper than coal-fired plants (p 117).

Production costs reflect a 5% increase above comparable 1954 figures. Production costs average 3.25 mills per net kwhr, with fuel accounting for most of this. Average production costs now split thusly: Fuel, 83%; labor, 11%; maintenance, 5.5%; water, lubrication, and supplies, 0.5%. Unit labor cost average 0.35 mills per net kwhr; but for 100-Mw plants and smaller, they run about 0.63 mills; for 300-Mw plants and larger, they average about 0.2 mills (p 118).

Fuel prices are about the same, excepting gas which is up from an average of 16.6¢ per million Btu to 21.3¢. Heat rates are about as you'd expect them, and station plant factor runs about 69%—the same as in 1954. Utilization factor averages 103%, below the 1954 figure of 106.4%. Most outstanding survey statistic: 80% of the capacity reported now uses reheat, compared with 55% of the last survey (p 118).

With an eye toward labor and large stations, it appears that the industry is reaching the point of diminishing returns in its present methods of using station labor. However, manpower requirements are up in small stations, and down in medium stations (p 121).

WASHINGTON ▶ **FPC's staff, the National Hells Canyon Assn, and the State of Oregon** have attacked an FPC hearing examiner's decision favoring Pacific Northwest Power Co as developer of the Snake River at the Mountain Sheep-Pleasant Valley hydroelectric sites. Not enough flood control, they claim (p 105).

EVENTS ▶ **Transmission budgets, including rights of way, will run about $1.3** billion for the industry during the 1957-59 period, a recent EW survey shows (p 103) . . . Arnold R. Jones pledges he'll do his "darndest" for TVA (p 108) . . . EEI drafts all-out attack against employee ignorance of American economics vs collectivism (p 107) . . . AG&E's Tanners Creek plant wins top spot in 10 most-efficient power plants (p 100) . . . AG&E's Donald Cook says charges of federal "subsidy" in accelerated amortization program are phony and were known to be phony at the time they were made (p 106).

PREVIEW OF THIS WEEK'S ELECTRICAL WORLD

ATOMIC ▶ **AEC's Advisory Committee on Reactor Safeguards reports** that Yankee Atomic Electric Co's proposed power reactor will be safe to operate **(p 101).**

CONSTRUCTION ▶ **Kansas City P&L has cut manhours 60% required for drilling holes** for small cables that cross streets or driveways. How? The company uses an auger driven by compressed air. It makes a 3-in. hole, and can drill up to 8 in. with an appropriate bit **(p 135).**

GENERATION ▶ **What's the thickness of an eroded studded boiler tube** along chill rings? The depth of cavitation can be determined with a device illustrated and explained on **p 135.**

DISTRIBUTION ▶ **You can get more out of distribution regulators** by limiting their range to less than full regulation. This increases their load capacity. For instance, if limited to one-half normal range, a distribution regulator—with little change in design—can carry 160% of normal full-load current. In their article on this subject, authors Enos and Brown discuss regulators as applied at a feeder's source, somewhere along the feeder, at several places in the feeder, and in combination with capacitors for satisfactory voltage regulation **(p 110).**

FINANCE ▶ **Don't overlook the 15% increase in cost of money when computing** the rate used to capitalize interest during construction **(p 199).**

REGULATION ▶ **A listing of state public service commissions that have adopted** original cost and fair value bases for establishing the rate base and rate of return has been prepared **(p 199).**

SELLING ▶ **Robert Nortier, a Rochester, N.Y., dairy farmer, figures** that electricity, interest, and depreciation on his farm equipment runs only $3,200 a year. In contrast, labor would cost over $5,000 a year—and wouldn't be as reliable as electricity **(p 142).**

PEOPLE ▶ **Power Reactor Development Co has appointed Robert W. Hartwell** as general manager . . . Kaiser Aluminum & Chemical Corp has named J. T. Dugall general manager of its new electrical conductor division **(p 208).**

MANUFACTURERS ▶ **An automatic load-frequency control system has been developed** which now controls operation of two Niagara Mohawk steam power plants from a nerve center in downtown Buffalo **(p 174).**

NEW EQUIPMENT ▶ **Manhole ventilating heaters have a 160-w generator** attached so work crews can use a 100-w soldering iron and an electric light at the same time . . . Station post insulators for EHV switch and bus duty are exceptionally sturdy **(p 148).**

ENGINEERING TRENDS

Automation helps to increase efficiency of electrostatic precipitators by constantly correcting power input whenever necessary to maintain the desired sparking rate for the installation according to an article in a recent issue of "Combustion".

Standardizations on 30- to 50-amp watthour meters for general purpose use is foreseen in the high accuracy the new extended range designs maintain throughout the load range now covered by 15-amp meters. Such a change would make general purpose metering adequate for practically all residential service applications as well as many more small commercials.

Transistors will not make vacuum tubes obsolete. Actually these devices complement each other. Tubes can operate at much higher temperatures; transistors have longer theoretical lifetimes. Transistors are very small and sturdy, but so are some tubes.

"One-Way" magnets have recently been discovered. They will switch polarity in a strong opposing magnetic field, as ordinary magnets do, but they reorient to their original polarity when removed from the magnetic field. This ordinary magnets do not do. Nothing but high temperatures can destroy the magnetism of the new magnets.

Utilizing nuclear energy either as a heat or electrical power source in combination with saline water conversion distillation processes is being studied by Fluor Corp.

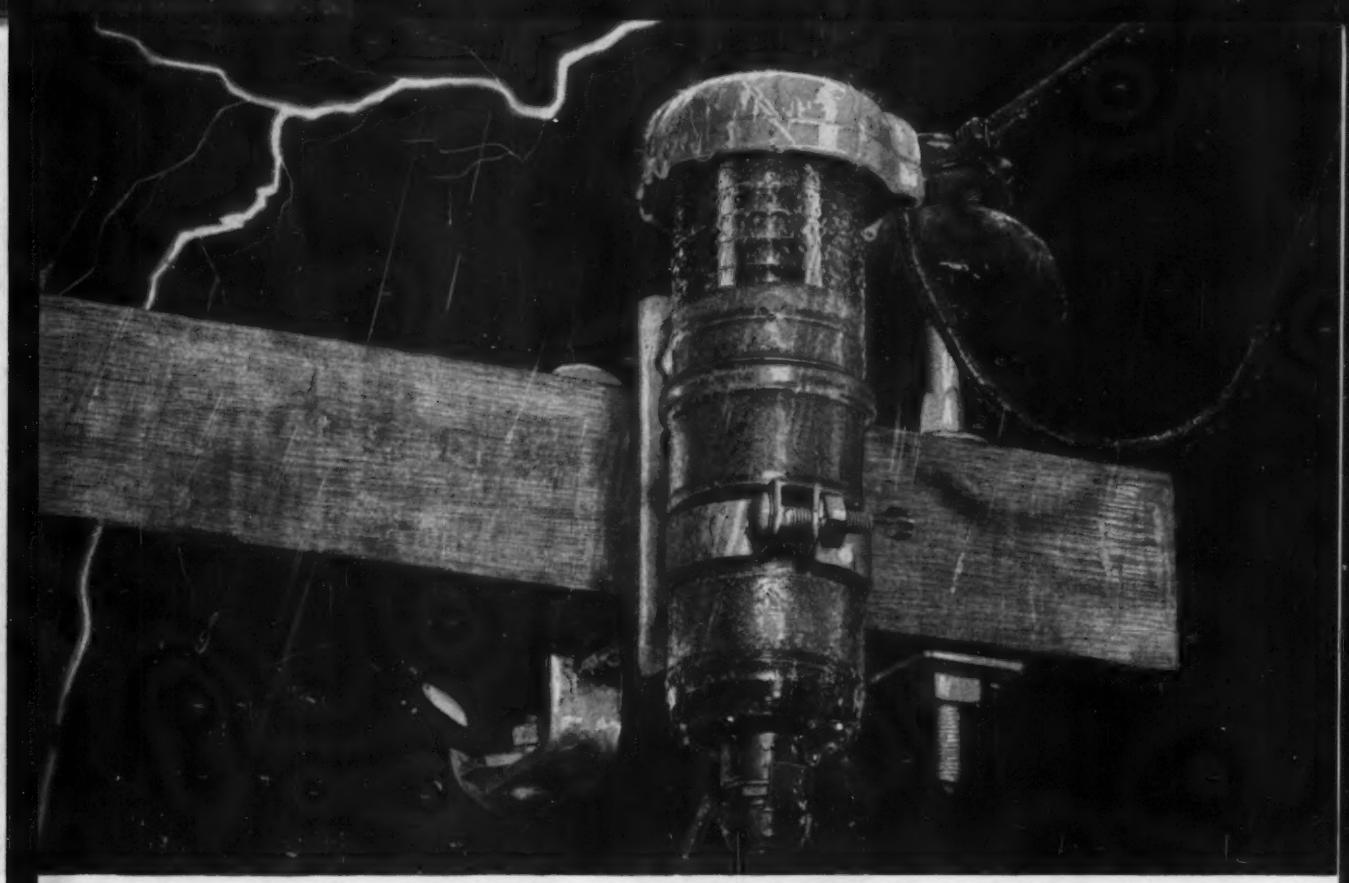
Pento dissolved in creosote fortifies protection of poles. The combination gains effectiveness by inhibiting a wider range of organisms than either preservative alone and promises enough gain in pole life to justify the increase in treating cost.

Artificial drying reduces serious checking of green poles, reduces shipping weight 20% or more, and offers important savings in shipping costs.

FROM EDITORS IN THE FIELD

Hot sticks may be dried in an air conditioned room. This practice, obviates drying ovens but requires more time to remove the moisture, reports a Southeastern utility.

Kwhr in and out of important interconnections may be telemetered to computing and dispatching centers on an automatic periodic schedule. Arizona Public Service Co is studying such a system, which would utilize their microwave network. Dispatchers would have printed records of totalized energy shipped and received, for checking commitments, within seconds after the end of the period. And intercompany billings would be calculated, printed, and mailed by a computer.



Why More Utilities Are Selecting L-M Type E Valve Arresters

L-M valve-type distribution lightning arresters have established an outstanding performance record by giving millions of service years of reliable protection. The Type E has been a leader in the field, and hundreds of thousands have been giving excellent service for many years. The failure rate is phenomenally low.

Here are some of the reasons for this remarkable record, and for the great increase in customer preference for the L-M Type E valve arrester.

Balanced Sparkover: Spark gap is a ladder-gap design, pre-set and then permanently sealed in the arrester housing. It cannot be knocked or burned out of adjustment. Gap is precision-made to assure optimum balance between 60-cycle sparkover and impulse sparkover.

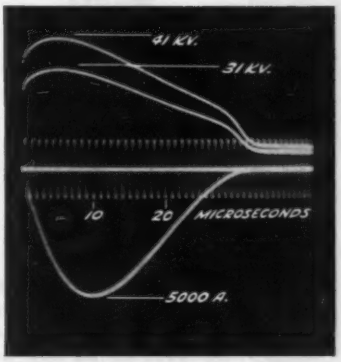
Low IR Drop: L-M now has a new Type E arrester, the E-3, which provides even lower IR drop than its popular predecessor. The new Type E-3 also provides greater durability and discharge capacity. These advantages are made possible because the new Type E-3 has an improved gap which provides greater 60-cycle interrupting ability, permitting reduction of the resistance of the valve element. The oscillogram shows the improvement in IR drop between the Type E and the new Type E-3.

Positive Protection: L-M valve arresters have a Pyrex glass housing which permits visual inspection of the spark gap in the field. Should the arrester become damaged, telltale evidence can be readily seen through the glass. If the arrester should fail to interrupt 60-cycle follow current for any reason whatsoever, L-M's patented Isolator provides positive assurance against grounding the feeder by disconnecting the ground lead from the arrester.

Other features include Zincilated (Zincilate No. 100) arrester housing clamp, fibre-glass cap, and fibre-form packaging. New packaging provides additional strength to the carton so arresters can be stacked easily on pallets.

Get Complete Information

Get the whole story of L-M arrester performance and application. Ask the L-M Field Engineer, or write for a copy of bulletin on the new Type E-3 arrester, to Line Material Industries, Milwaukee 1, Wisconsin.



Oscillogram shows reduction in discharge voltage in the new Type E-3 valve-type lightning arrester. Curves are for a 9 kv unit. IR drop has been reduced from 41 kv to 31 kv—a remarkable improvement in a unit that already has established an enviable performance record over many years' service.

LINE MATERIAL Industries

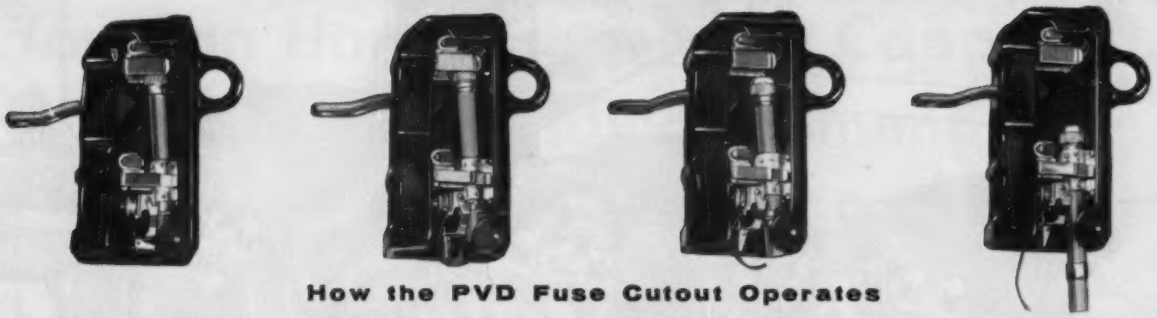
McGRAW-EDISON COMPANY

LM Lightning Arresters

McGRAW EDISON

DOOR IS EASY TO OPEN. Handle is high up on the door to assure good leverage, and hole is large enough to insert hookstick easily, yet small enough so hook will not slide down or jump out. Available in standard-duty ratings and new heavy-duty interrupting ratings of 5000 amps. at 5.2 kv and 8000 amps. at 2.6 kv.

THE DOOR IS REMOVED, unhooked, and replaced, all with the hookstick. A special hook on the door assembly makes this convenient.



How the PVD Fuse Cutout Operates

1. Fused position. Door always closed—operation is independent of door. As the link blows, spring-loaded lever flips out the fuse link leader—fast!

2. This instantly separates blown link parts, clearing the arc inside the tube. It also releases a latch which permits the bright yellow fuse tube to drop out.

3. Upper spring contact pushes the tube down and follows it part way, giving extra time to clear the arc, and eliminating burning of contacts. Action is positive.

4. Cartridge drops to indicating position easily seen from the ground. Large air gap prevents re-establishing the arc. No leakage, no radio interference.

How L-M's Famous PVD® Cutouts Provide Faster, Safer Operation

Positive dropout operation provides indication easily seen from the ground. For re-fusing, door is easily removed and replaced with hookstick; high-pressure silver contacts insure long life. Now also available in heavy-duty designs.

By **GEORGE W. COOPER**
Product Manager
Protective and Power
Switching Equipment
Line Material Industries

When a fuse blows in L-M enclosed dropout cutouts, a latching lever flips out the fuse and permits the cartridge to drop to indicating position. Upper contact spring follows tube part way, giving extra time to clear arc inside the tube. Contact spring also provides a downward thrust on the tube to assure positive dropout operation.

The large air gap which results between the tube and the upper contacts on the box prevents re-establishing of the arc. This assures long service, eliminates leakage and possible radio interference. Door remains closed following fuse operation; parts are always protected.

Positive Low-Resistance Contact

L-M's silver-plated spring contacts and round blade provide a very high-pressure, multi-point contact surface. In addition to the side contact clips, the spring-top clip provides additional contact and current path.

L-M's heavy contact construction provides ample metal to conduct heat away rapidly from the multi-point contact surface. This results in cool operation, and resistance is kept low.

Blown Fuses Easily Located

When the cartridge in L-M's enclosed cutout is in indicating position, it is easily seen from the ground—from any angle. The lineman locates the blown fuse quickly; thus he saves operating time and restores service faster.

Easy To Re-Fuse With Hookstick

The pull ring handle on L-M's PVD cutouts is high up on the door to assure good leverage when operating the door. This, plus a hook on the flipper assembly, make it easy to open and unhook the door, and to replace it with a spare fused door, the whole job being done with the hookstick . . . in just a few seconds.

In the open position, all parts of the door and cartridge assembly are electrically dead.

When the door is closed, the two hinges and the lower contact hold the door and cartridge assembly firmly. This, plus the guiding action of the top contact, assures that the door will close properly every time.

L-M Family of Dropout Indicating Cutouts

Interrupting Capacity Amp.	5.2/2.6 kv		7.8 kv	
	50 Amp.	100 Amp.	50 Amp.	100 Amp.
2000/3000	PVD			
3000/5000		PVD		
5000/8000	PHV*	PIV*		
2000			PVD	
3000				PVD

**New heavy-duty ratings*

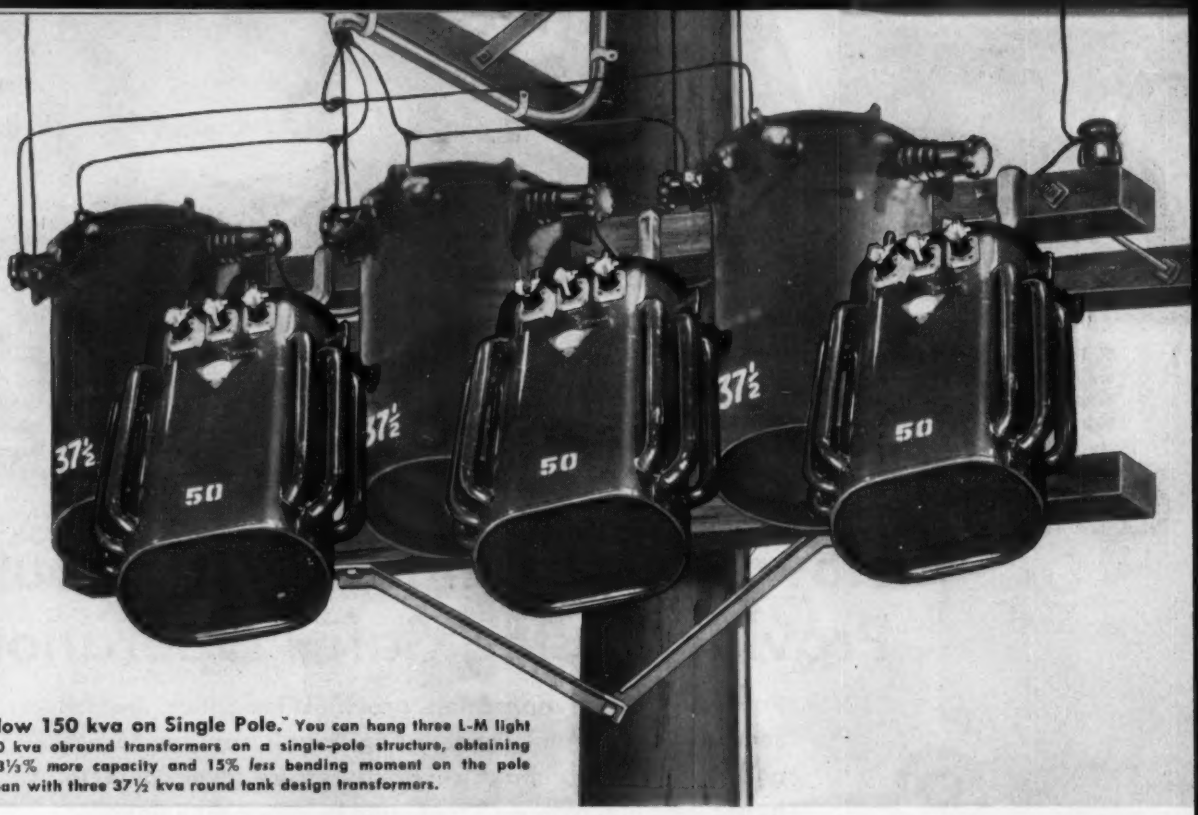
In addition to the dropout indicating cutouts above, L-M offers a complete line of non-dropout indicating and non-dropout fuse cutouts.

Ask your L-M Field Engineer for more complete information, or write Line Material Industries, Milwaukee 1, Wisconsin. In Canada: Canadian Line Materials, Ltd., Toronto 13, Ont.

LINE MATERIAL Industries
McGRAW-EDISON COMPANY
fuse cutouts and fuse links

318

McGRAW EDISON



Now 150 kva on Single Pole. You can hang three L-M light 50 kva obround transformers on a single-pole structure, obtaining 33⅓% *more* capacity and 15% *less* bending moment on the pole than with three 37½ kva round tank design transformers.

How L-M Obround Design Provides Additional Capacity On Structures

New obround tank design is smaller, lighter, has shorter moment arm, retaining all outstanding Round-Wound® performance characteristics.

By **ALVIN B. COYLE**
Product Manager
Transformers
Line Material Company

Now you can hang transformers of larger capacity on a pole structure with L-M's lighter, smaller obround transformer tank design. The additional capacity is obtained without changing outstanding performance characteristics of L-M's Round-Wound design.

Less Weight

The obround design provides a smaller tank with less transformer oil, resulting in a lighter, easier-to-handle transformer. Cooling tubes are installed where necessary to provide the cooling surface for maintaining the same low hot-spot and top oil temperature-performance characteristics found in all other L-M transformers. In addition, the transformer's repetitive overload capacity is improved as the result of the faster transfer of heat from the coils to the cooling air.

Shorter Moment Arm

L-M's new obround design brings the center of gravity closer to the pole, which reduces the moment arm distance from the pole. The combination of lighter weight and less moment arm distance substantially decreases the total bending moment on the pole and crossarms, and thus greatly increases the potential capacity of all your transformer structures.

You can take advantage of savings such as these:

Larger transformers can be hung closer to the top of the pole, eliminating the need for a higher pole and additional spacing.

Single-pole, three-phase transformer structures can now serve more load with the additional transformer capacity available. New 50 kva obround transformers have less bending moment on the pole and on crossarms than previous 37½ kva round tank design. Here L-M's light obround transformers may eliminate the need for costly two-pole structures.

Pole-Mounted 167 kva Transformers

L-M's light-weight 167 kva transformer can be pole-mounted; provides a full 167 kva of capacity on a single-pole structure. And it, too, provides L-M's well-known overload capacity.

To serve three-phase loads you can hang three L-M light 167 kva transformers or 500 kva on a two-pole structure, eliminate expensive platforms, ground pads, or vaults in many instances, and make further use of existing facilities.

L-M's light, obround design transformers are available in single-phase 5 kva through 167 kva in each standard distribution voltage class.

Get Details On Lighter-Weight Obround Transformers

Ask the L-M Field Engineer for application information, weights and dimensions on L-M obround transformers and the exclusive Round-Wound design. Or write Mr. Coyle at Line Material Industries. Transformer Division, Zanesville, Ohio (McGraw-Edison Company).

219-A

LINE MATERIAL Transformers

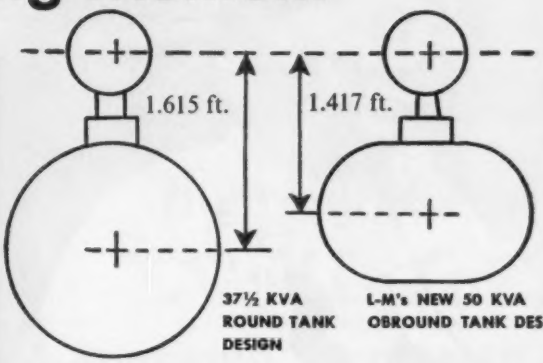
You Can Hang 33⅓% More Capacity With 15% Less Bending Moment

COMPARE 37½ kva round tank design
50 kva L-M obround tank design

37½ kva ROUND tank design:
Moment arm from center of pole. 1.615 ft.
Weight. . . . . 800 lbs.
Bending moment 800 x 1.615. . . . **1292 ft.-lbs.**

50 kva L-M OBROUND tank design:
Moment arm from center of pole. 1.417 ft.
Weight. . . . . 775 lbs.
Bending moment 775 x 1.417. . . . **1098 ft.-lbs.**

L-M's new 50 kva obround transformer has 15% less bending moment than the 37½ kva round tank design.



Less Bending Moment—New obround tank design reduces the moment arm distance from the pole. The combination of lighter weight and smaller moment arm distance greatly decreases the total bending moment on the pole. When crossarm mounted, the lighter weight substantially reduces the bending moment on the crossarms.

Less Weight, Faster Cooling—The obround design affords a small tank and less transformer oil, resulting in a lighter, easier-to-handle transformer. Cooling tubes are installed where required to provide sufficient cooling surface.

In addition, oil ducts, located throughout the coil and between the coil and cruciform cross-section of the wound core, contribute to uniform efficient cooling.

Rapid transfer of heat provides faster cooling of the unit, increasing its repetitive overload capacity.

Plus Outstanding Round-Wound Performance Characteristics

Both the physical and performance characteristics of L-M's obround tank transformer were considered in detail. The advantages of lighter weight and shorter moment arm were accomplished with no sacrifice of outstanding Round-Wound performance characteristics.

Low Exciting Current: the continuously wound core of oriented-grain silicon steel strip provides a uniform flux path, thus permitting low exciting current.

High Impulse Strength: high-voltage windings are on the outside of the coils, providing maximum distance between the high-voltage windings and the core. This permits ample creepage distance with generous insulation.

High Short-Circuit Strength: round coils naturally resist radial short-circuit forces without damage or distortion. Sturdy core clamps and strong blocking aid in preventing axial movement of the windings under short-circuit conditions.

High Short-Time Overload Capacity: cruciform cross section of wound core and ducts between windings and layers provide excellent cooling for the entire unit.

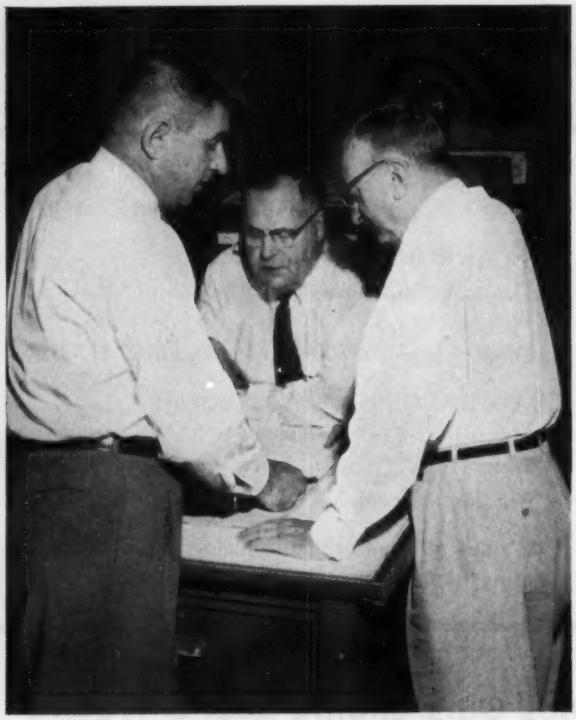
Now you can hang 167 kva directly on the pole, yet L-M's new lightweight obround has full 167 kva continuous rating and no sacrifice in overload capacity.

LINE MATERIAL
LM
Transformers

219-R3

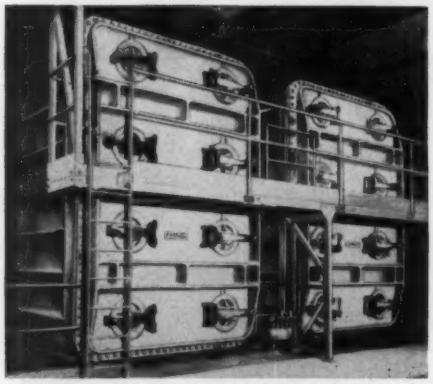
Before you place your next order...

It's saved many weeks, even months of engineering and executive time for scores of power companies! Basically, the idea is to shift as much of the work load as possible from the customer to C.H. Wheeler. By working this way, long conferences are replaced by short phone calls, and lengthy customer-prepared engineering specifications are supplanted by thumbnail performance sheets.

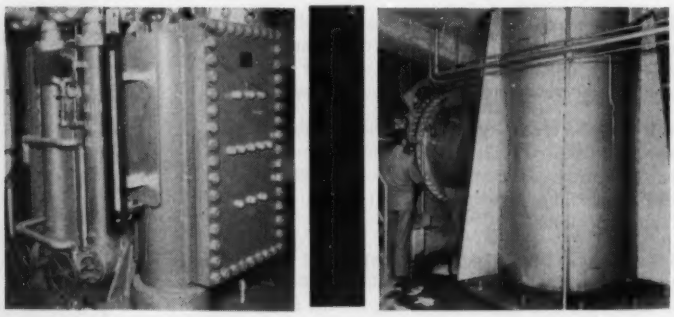


Since Wheeler specializes in designing and building condensing equipment, its Engineering Department is set up to take this bare minimum of data from the customer, and work up a comprehensive proposal from it alone. Here you see several department heads of C. H. Wheeler discussing engineering design prior to preparing a proposal for a C. H. Wheeler client.

Discover C. H. Wheeler's time-saving way to buy steam condensers



We often save clients up to 4 months' time by sending Wheeler engineers to work "on the board" at clients' offices, instead of mailing drawings for approval. Above is a typical installation—a 105,000 sq. ft. Dual Bank Divided Water Box Unit, installed at a New York station.* It condenses 950,000 lbs. steam/hr.



Other C. H. Wheeler power plant equipment includes steel-shell "Tubejet"® Air Ejectors (left) as installed at eastern plant*, Circulators (right) which in the same plant deliver 86,500 gpm water, and Condensate Pumps. See your representative or write for details on the time-saving way to buy Dual Bank Surface Condensers and other power equipment.

**Names of these and other power stations equipped by C.H. Wheeler supplied on request.*

C. H. Wheeler Mfg. Co.

19TH & LEHIGH AVENUE *Philadelphia 32, Pennsylvania*

Steam Condensers • Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Products

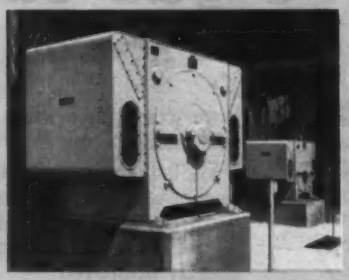
ELLIOTT
Fabri-Seal
INSULATION

not one insulation failure in 8 years...

High Surge JOLT confirms insulation strength of Elliott coils

1,900,000 hp of squirrel-cage induction motors

are now in service all over the world (including 700,000 hp of weather-protected motors which are operating in extreme weather and atmospheric conditions). Since 1948 (when Fabri-Seal insulation was first used) not one of these motors has experienced an insulation failure—an unprecedented record in large motor coil service. Seen here is an installation of two Elliott weather-protected motors—extra-protected with Fabri-Seal insulation.



Rigid testing insures top performance

All Elliott large induction motor coils are tested turn-to-turn by high surge voltages—many times greater than the electrical conditions which they will encounter in actual field service. In addition, these coils are given a series of high voltage coil-to-ground tests, when coils are made and during their installation in the machine.

This is all part of Elliott's thorough production coil-testing procedure aimed at providing users with the optimum in superior, long-lasting stator coils, to withstand all mechanical or electrical stresses to which they are exposed. All tests exceed AIEE requirements. Write the Elliott Company, Ridgway, Pa. for complete details on Fabri-Seal coil insulation.

ELLIOTT Company

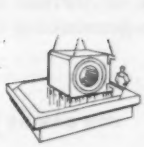
R7-31

FIVE OTHER REASONS WHY ELLIOTT "FABRI-SEAL" INSULATION INSURES LONGER SERVICE LIFE

IMMERSION-TEST EVALUATES COIL LONGEVITY

MYLAR®-BACKED MICA SEALS COIL SLOT SECTIONS

SEALED AT ALL VULNERABLE POINTS



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4 IN 4

4 orders in 4 years for

Westinghouse gas turbines

as base load units in one station

As BASE LOAD GENERATING UNITS, an internationally known company installed a Westinghouse gas turbine-generator in 1954, another in '55, another in '56 and a fourth is now on order. These repeat installations are real evidence of reliable performance.

For use in your station . . .

. . . as a base or as an auxiliary power plant, the gas turbine offers you even more than reliability. For example . . .

Capital outlay is far lower than for any other type of turbine and there's no need for steam-generating facilities. Likewise, lower costs for installation, operating labor, maintenance and floor space.

By using the gas turbine exhaust as highly preheated combustion air, for feedwater heating or for generating steam, the overall heat balance of many stations can be greatly improved.

Challenge us to show you how a modern Westinghouse gas turbine might be the most economical solution to demands for greater capacity or increased operating efficiency. Contact your Westinghouse representative, or write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-50597

YOU CAN BE SURE...IF IT'S Westinghouse

Butyrate conduit means direction changes without fittings

The semi-rigid nature of Tenite Butyrate allows the engineer maximum flexibility in planning and revising—since many direction changes can be made without costly and job-prolonging fittings.

Butyrate conduit means resistance to corrosion

Conduit of Tenite Butyrate is unaffected by corrosive and electrolytic action of soil. This is your assurance of many years of trouble-free service.

What can conduit of Tenite Butyrate plastic mean to you?

Conduit made of Tenite Butyrate plastic means many things to many utilities—for use in carrying both electric power and telephone cables.

To Long Island Lighting Company, Hicksville, N.Y., for example, Butyrate conduit meant resilience—which enabled it to meet conditions encountered in filled-in marsh areas. Conduit of Tenite Butyrate "gives" with ground movement instead of parting or fracturing.

To other companies it may mean: freedom from corrosion, high impact strength, non-inductance, ease in cutting and joining, extra-smooth walls, or semi-rigidity.

All of these benefits of Tenite Butyrate plastic are available to you—plus the economies in installation and maintenance which accompany them.

Discover how you can share in these benefits. For complete information and a list of suppliers in your area, mail the coupon below.

1932—EASTMAN'S 25TH YEAR IN PLASTICS—1957

Butyrate conduit means lightness in weight

Conduit of Tenite Butyrate is extremely easy to handle, thanks to its light weight. A 20' length of 4" conduit can literally be carried "with one hand behind your back."

TENITE
BUTYRATE
an Eastman plastic

EASTMAN CHEMICAL PRODUCTS, INC.
subsidiary of Eastman Kodak Company, Kingsport, Tennessee

Please send me information on cable conduit made of Tenite Butyrate and a list of companies manufacturing Butyrate conduit and fittings.

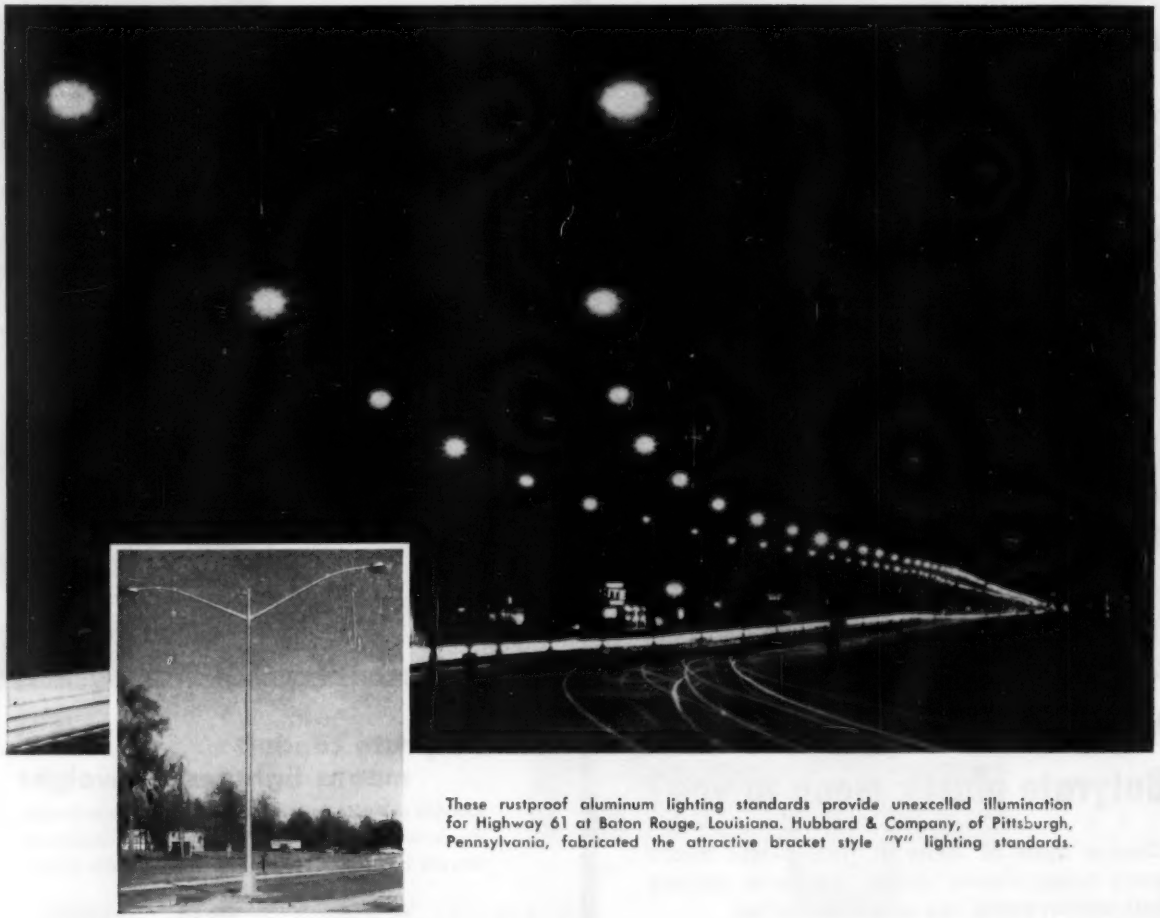
NAME_____

POSITION_____

COMPANY_____

STREET_____

CITY_____ ZONE_____ STATE_____



These rustproof aluminum lighting standards provide unexcelled illumination for Highway 61 at Baton Rouge, Louisiana. Hubbard & Company, of Pittsburgh, Pennsylvania, fabricated the attractive bracket style "Y" lighting standards.

Louisiana installs corrosion-free, maintenance-free lighting standards at no extra cost

Lighting standards of Alcoa® Aluminum are rapidly becoming the people's choice in every state of the Union. The reason? Their first cost is the last cost. Once installed, they provide years of maintenance-free service. Even under highly corrosive and moist conditions, aluminum stays rustproof, new-looking longer. It can never become an eyesore; it never requires a protective coating of any kind.

Because of their light weight, aluminum lighting standards cost less to ship and handle—they install easier and faster for additional savings in construction costs. Yet, these lightweights are heavyweights for punishment. They'll stand up in hurricane winds of 100 miles per hour and more. And, because interiors stay free from accumulations of rust and scale, they guard electrical circuits against short circuits and service interruptions.

Alcoa does not make lighting standards, but we can supply you with the names of manufacturers who do. For these names and any additional information that you might need about lighting standards of Alcoa Aluminum, write to Aluminum Company of America, 1977-K Alcoa Building, Pittsburgh 19, Pa.

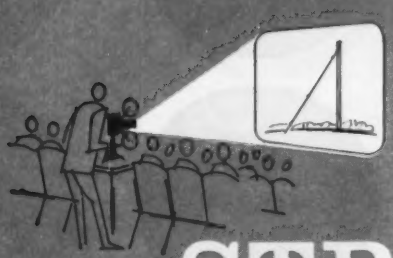
WE CHOSE ALCOA ALUMINUM MILL PRODUCTS

YOUR GUIDE TO THE BEST IN ALUMINUM VALUE

NEW!
"ALCOA THEATRE"
Exciting Adventure
ALTERNATE MONDAY EVENINGS

The Reliable Electric Company

invites you to see and hear



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a fifteen minute sound-color film showing
the manufacture, testing and uses of Strandvise.
Your Reliable representative or
distributor will arrange a showing.

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FRANKLIN PARK, ILLINOIS

Reliable

A blue chip pump...

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COLUMBUS & SOUTHERN OHIO ELECTRIC COMPANY
Columbus, Ohio

COMMONWEALTH EDISON COMPANY
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CONNECTICUT LIGHT & POWER COMPANY
Berlin, Connecticut

FLORIDA POWER CORPORATION
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KANSAS GAS & ELECTRIC COMPANY
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LONG ISLAND LIGHTING COMPANY
Long Island, New York

MISSISSIPPI POWER COMPANY
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PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
Manchester, New Hampshire

PUBLIC SERVICE COMPANY OF NEW MEXICO
Albuquerque, New Mexico

PUBLIC SERVICE COMPANY OF OKLAHOMA
Tulsa, Oklahoma

ROCKLAND LIGHT & POWER COMPANY
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TEXAS POWER & LIGHT COMPANY
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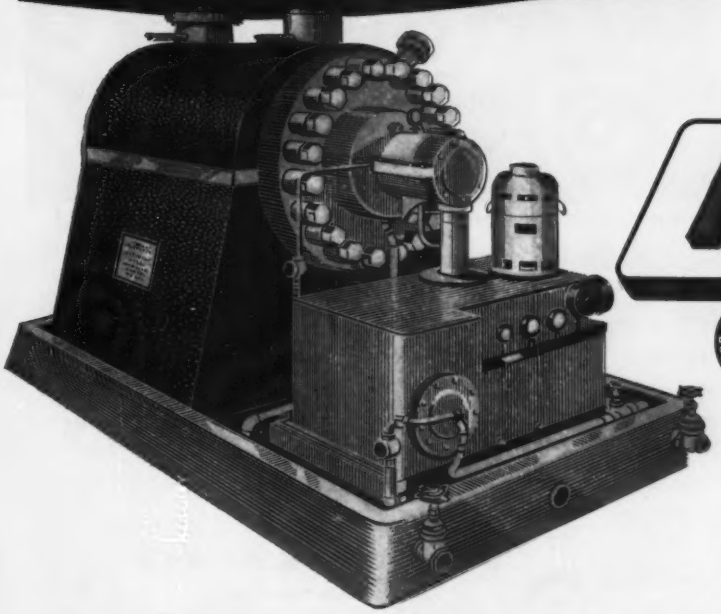
PACIFIC Boiler Feed Pumps



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HUNTINGTON PARK, CALIFORNIA

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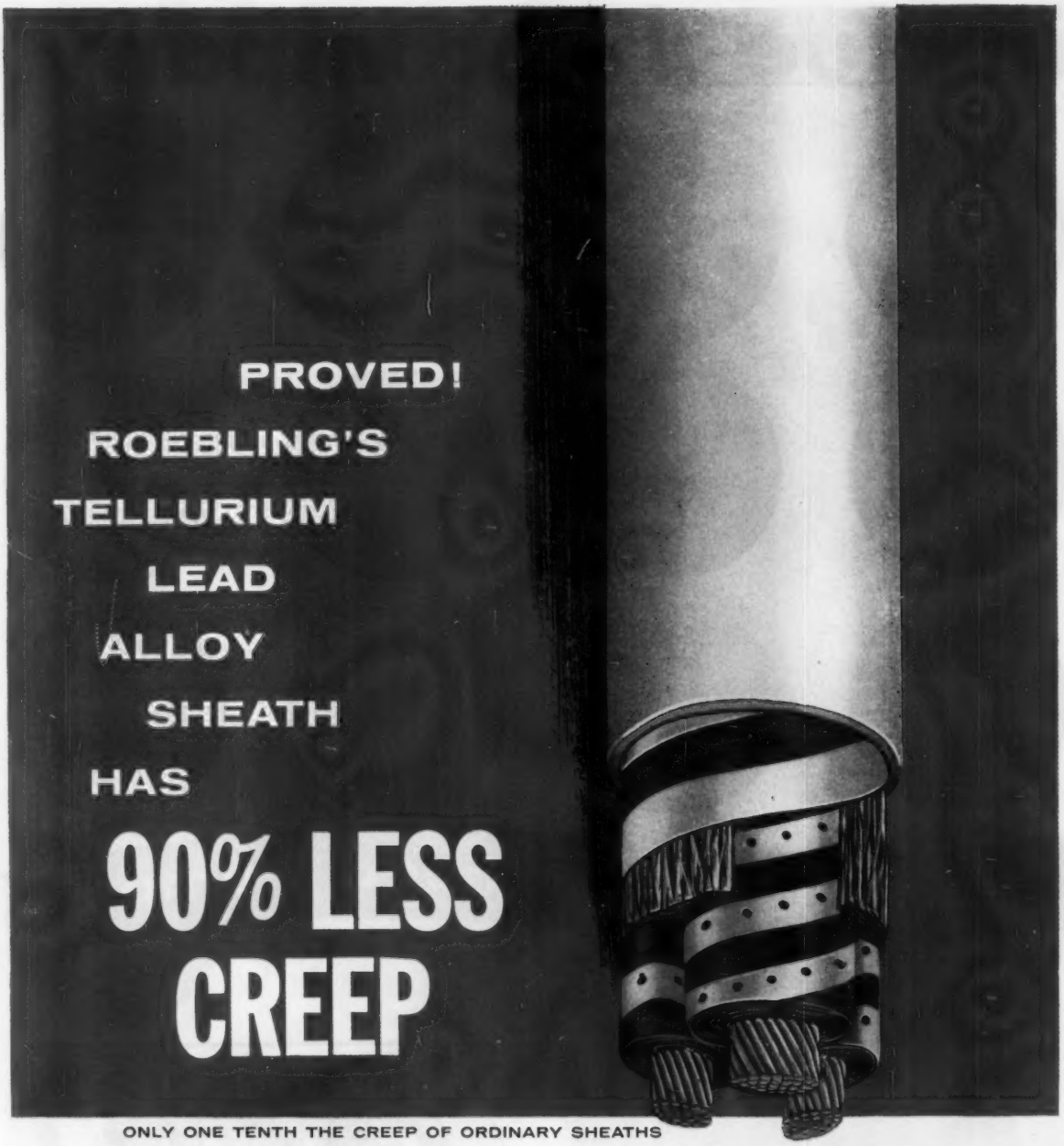


ONLY ONE TENTH THE CREEP OF ORDINARY SHEATHS

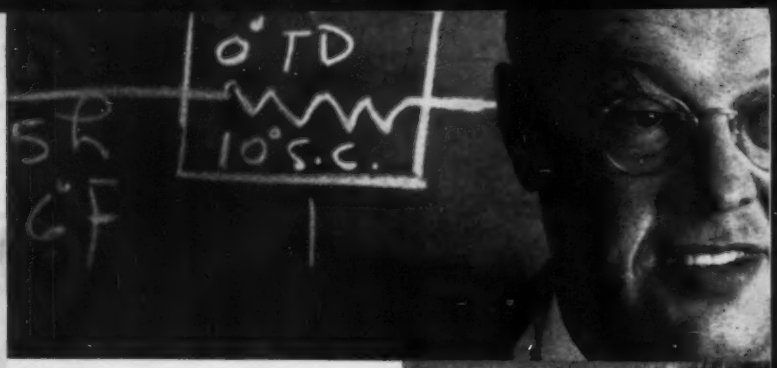
Thousands of feet of Roebling Paper Power Cable with Tellurium Lead Alloy Sheath now in service bear out Roebling's exhaustive laboratory tests. This unusual sheath creeps only one tenth as much as ordinary copper-lead sheath! What's more, tests prove this sheath has 4½ times more bending life . . . outstanding stability under heat . . . retains excellent ductility year after year.

Sound good? It is—and so is the unexcelled paper power cable inside! In fact, if you're thinking about dependability *tomorrow*, as well as today, investigate this superior cable.

Get test data and an informative folder about Roebling Paper Power Cable with Tellurium Lead Alloy Sheath by writing Electrical Wire Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

ROEBLING

Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation



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...the most important investment you can make is in the creative ability of men.

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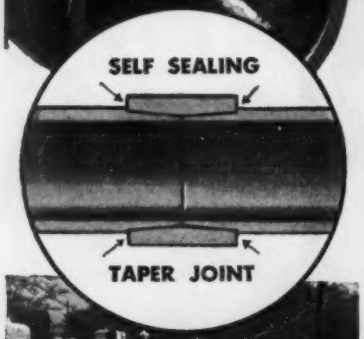


Orangeburg Fibre Conduit Prolongs Cable Life

Protect cable sheath from abrasion and you prolong the life of underground cables, say utility engineers. Scoring of cable sheath creates "trouble spots" that shorten cable life.

That's where Orangeburg Fibre Conduit plays an important part in keeping cables healthy. Orangeburg's smooth bore, its low coefficient of friction minimize the danger of abrasion when cables are pulled in, as well as later on during cable movement. By protecting cable sheath from abrasion, Orangeburg Fibre Conduit adds years to cable life.

Orangeburg's impermeable wall and watertight joints protect cables from corrosive ground waters. Its nonmetallic material is strong, tough, resilient, long lasting.

And, remember, Orangeburg lays faster and at lower cost than other types of conduit. It is light in weight, easy to handle, easy to tool on the job. Spacers, bends, fittings, 5° bend sections and lightweight tapering tool, all combine to simplify installation.

Since 1893, records of long life have proved Orangeburg's durability and economy.

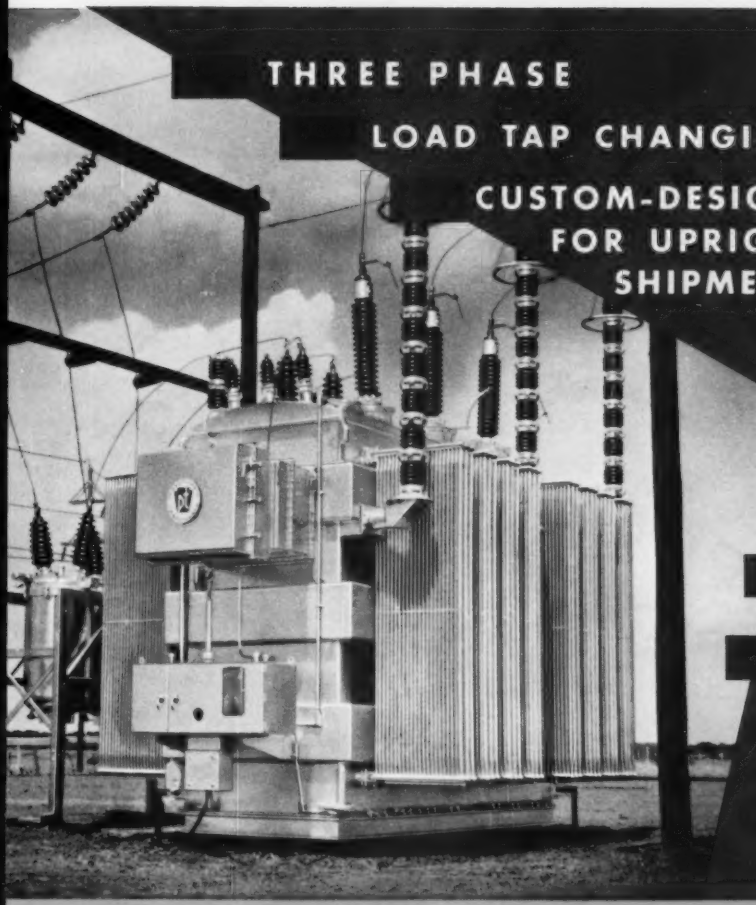
Orangeburg Fibre Conduit is distributed by Graybar Electric Company and General Electric Supply Company with branches and stocks in principal cities.

WRITE DEPT. EW-107 FOR NEW CATALOG 52.

ORANGEBURG MANUFACTURING CO., INC., Orangeburg, N. Y. West Coast Plant, Newark, Calif.

ORANGEBURG®
FIBRE CONDUIT

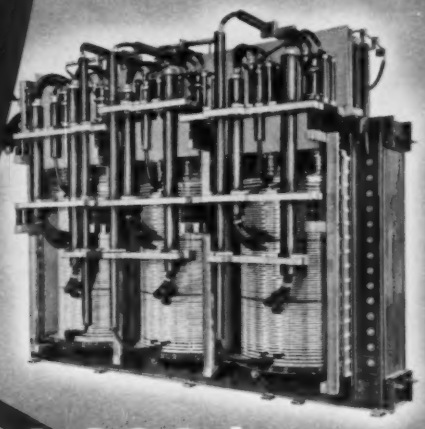
PENNSYLVANIA *Triple-rated* AUTOTRANSFORMER



THREE PHASE

LOAD TAP CHANGING

CUSTOM-DESIGNED FOR UPRIGHT SHIPMENT



34,000 kva
45,333 kva
56,666 kva

Three-phase, three-winding. Self-cooled, forced-air-cooled. High voltage: 133,010 Grd.Y/76,793 volts. Low voltage: 67,200 Grd.Y/38,800 volts, with LTC for ± 10% regulation in 32 steps of ⅝%. Tertiary voltage: 12,470△ volts.

Shown here as it was placed into temporary service with only the self-cooled rating of 34,000 kva in operation, this Pennsylvania Autotransformer will achieve its forced-air ratings of 45,333 and 56,666 kva by means of fans mounted underneath the radiators. The transformer was shipped to its Southwestern installation site in an upright position, completely assembled except for detachable radiators and other external accessories.

The function of this three-winding, triple-rated, Pennsylvania Autotransformer is to transmit power from a 133-kv system to a 67-kv system. The load tap changer, which is located in the neutral end of the low voltage winding, maintains a constant low voltage during variations in the high voltage input. The tertiary winding (12.4 kv) is for stabilization of the neutral and for suppression of third harmonic voltages.

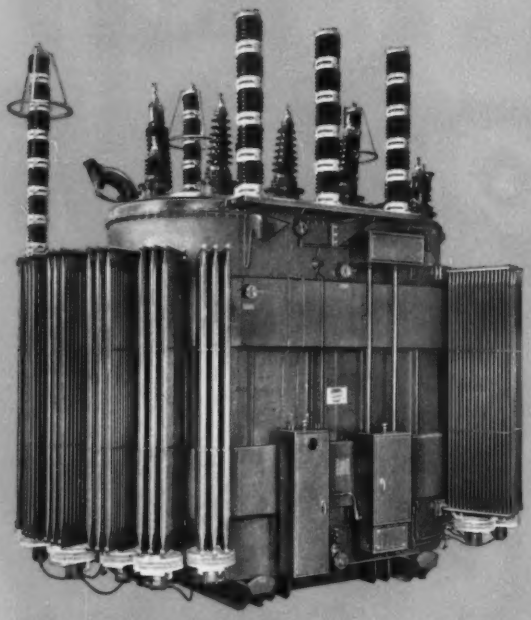
Pennsylvania Autotransformers are available in any kva and voltage size for:

- **INTERCONNECTION OF SYSTEMS**
- **PHASE SHIFTING**
- **GENERATING STEP-UP SERVICE**

Typical units on next 3 pages . . .

PENNSYLVANIA PENNSYLVANIA TRANSFORMER **POWER TRANSFORMERS**

PENNSYLVANIA



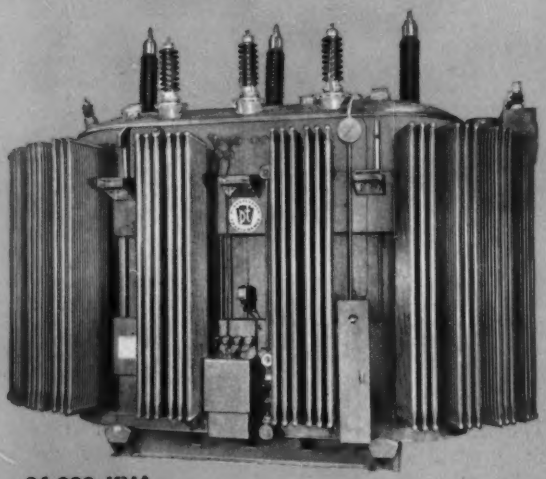
20,000/26,666/33,333 KVA

Three-phase, three-winding. Self-cooled, forced-air-cooled. High voltage: 132,000 Grd.Y volts. Low voltage: 66,000 Grd.Y volts. Tertiary voltage: 33,000Δ volts for loading.

The range of applications and sizes of Pennsylvania Autotransformers is determined solely by the needs of America's power producers. Pennsylvania is equipped to handle the largest power transformer requirements contemplated today . . . and its experience in the field of autotransformers ranges from 525-kva, single-phase units, to the large, three-phase transformers shown on these pages. Autotransformers produced to date have included both two-winding and three-winding units . . . some of the latter with the tertiary loaded and others with the tertiary designed for suppression of harmonics only. Either core-form or shell-form design may be utilized, depending on requirements. Load tap changing equipment is optional.

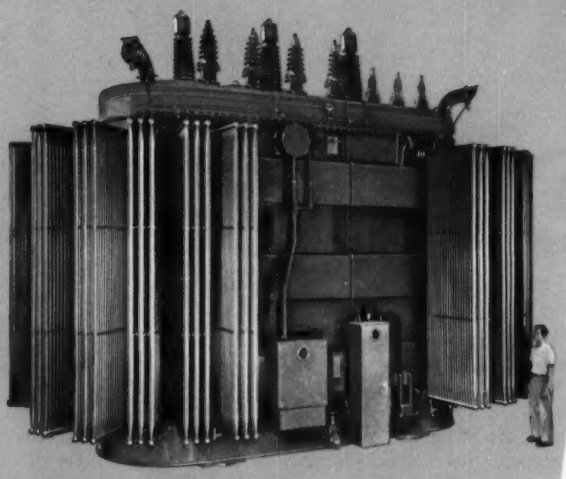
Whether your next autotransformer must serve a special need such as phase shifting, or is for interconnecting systems . . . Pennsylvania has the facilities and the capability to meet your requirements. Contact Pennsylvania Transformer Division, McGraw-Edison Company, Canonsburg, Pa.

WITHOUT LTC ←



36,000 KVA

Three-phase, three-winding. Self-cooled. Provisions for fans for 48,000/60,000 kva. Designed for both step-up and step-down service. High voltage: 136,800 Grd.Y/79,075 volts. Low voltage: 67,200 Grd.Y/38,800 volts. Tertiary voltage: 2400 volts for loading and suppression of harmonics.



60,000 KVA

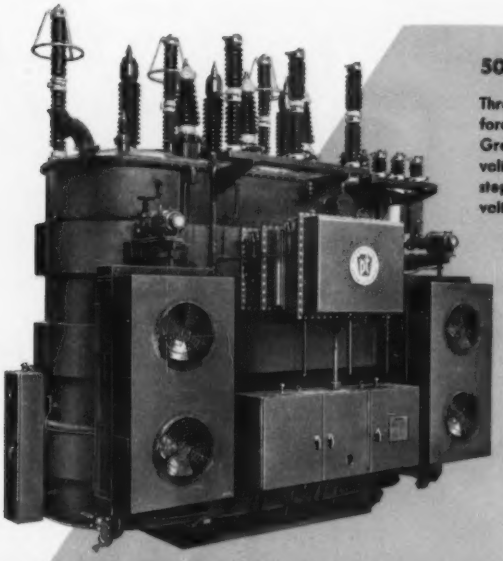
Three-phase, three-winding. Self-cooled. Provisions for fans for 75,000 kva. High voltage: 110,000Y/63,510 volts. Low voltage: 45,000Y/25,980 volts. Tertiary voltage: 13,200Δ volts for loading.

PENNSYLVANIA TRANSFORMERS pt

PENNSYLVANIA

AUTOTRANSFORMERS

Custom-Designed for Interconnection of Systems

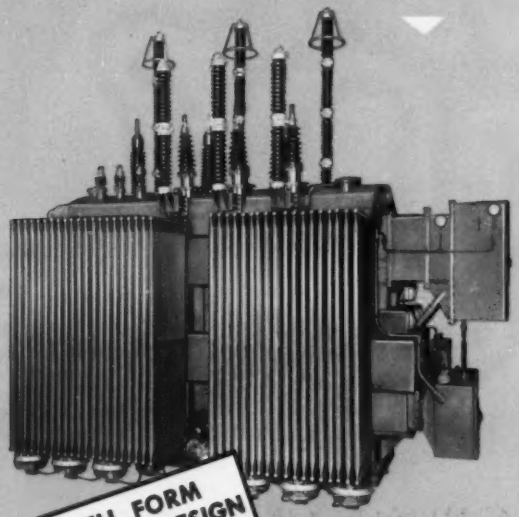


50,000 KVA

Three-phase, three-winding. Forced-oil, forced-air-cooled. High voltage: 132,000 Grd.Y volts. Low voltage: 69,500 Grd.Y volts with LTC for ±5% regulation in 32 steps of ⅝%. Tertiary voltage: 7200Δ volts for harmonic suppression.

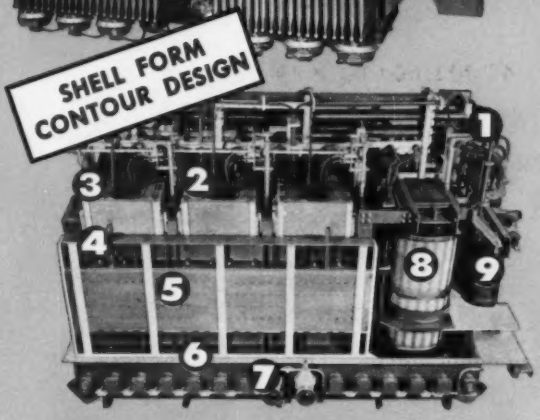
60,000/80,000/100,000 KVA

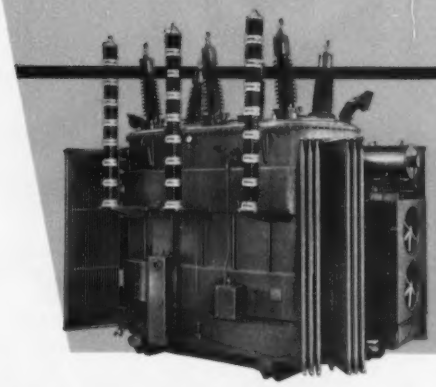
Shell form. Three-phase, three-winding. Self-cooled, forced-air-cooled, with forced-oil circulation for two higher ratings. High voltage: 132,000 Grd.Y volts. Low voltage: 69,300 Grd.Y volts, with LTC for ±10% regulation in 32 steps of ⅝%. Tertiary voltage: 13,200Δ for harmonic suppression.



➡ WITH LTC

1. Tap leads for load tap changing equipment supported in insulating tubing between coils and LTC panel.
2. Vertical cooling ducts in coils permit free flow of oil through coils.
3. Sturdy, fabricated box sections of core frame securely clamp coils to protect against mechanical forces during short circuits.
4. Core and coils clamped together with fabricated steel members. Core-and-coil unit can be handled separately as complete assembly.
5. Core cooled by both vertical and horizontal ducts.
6. Core-and-coil assembly rests on flange of bottom section of tank.
7. Oil enters common header after passing through radiators, and is recirculated by pumps for 80,000- and 100,000-kva ratings.
8. Series transformer in low voltage line.
9. Preventive autotransformer maintains a continuous circuit during load tap changing operation.





PENNSYLVANIA Phase Shifting AUTOTRANSFORMER

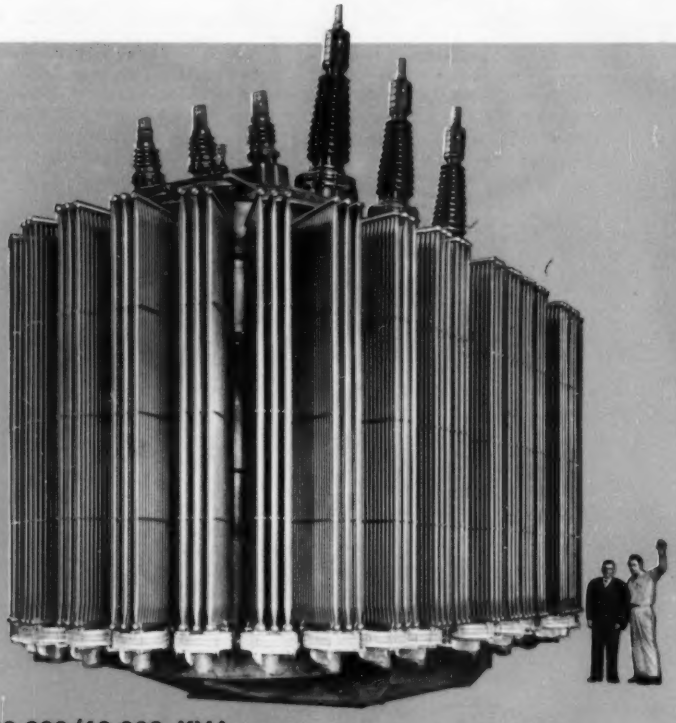
45,000/60,000/70,000 KVA

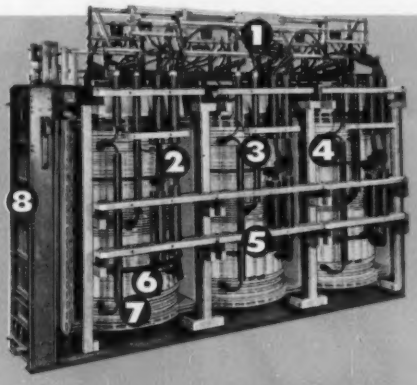
Three-phase, two-winding. Self-cooled, forced-oil-cooled with forced-air heat exchangers. Designed to provide 30° phase shift in 115-kv line. High voltage: 115,000Δ volts. Low voltage: 115,000Δ volts.

POWER TRANSFORMERS

PENNSYLVANIA *Dual Step-up* AUTOTRANSFORMER

...designed for Main Step-up Generating Station Service





1 Tap changer located above core and coils for easy access through cover of transformer.

2 Two sets of taps per coil assure excellent electrical and mechanical balance in windings.

3 All leads well supported and insulated in heavy pressboard tubes.

4 Continuous pancake winding in high and low voltage coils. Helical winding in tertiary coils.

5 Taps located in high voltage windings as well as low voltage windings.

6 Coils are precompressed and secured to prevent mechanical distortion under short circuit stress.

7 Extra heavy insulation at line ends of coils. Graded insulation at ground ends of coils.

8 Five-legged core reduces shipping height.

48,000/60,000 KVA

Three-phase, three-winding. Self-cooled, forced-air cooled. High voltage: 132,000 Grd. Y volts. Low voltage: 67,200 Grd. Y volts. Tertiary voltage: 13,200Δ volts.

This three-winding autotransformer has a self-cooled rating of 48,000 kva and a forced-air-cooled rating of 60,000 kva. Specially designed for "dual step-up" service, it takes the full capacity of the generator on the 13,200-volt delta tertiary winding and steps up the voltage to either 132,000 volts or 67,200 volts, or to both simultaneously. If the generator is out of service, the transformer permits full capacity transfer between the 132,000-volt and 67,200-volt systems through the auto connection in the high voltage winding.

Pennsylvania is experienced in the design and manufacture of autotransformers in all kva and voltage sizes and for any purpose: interconnection of systems, phase shifting, as well as generating station step-up service. Transformers are available with or without load tap changing. Pennsylvania Transformer Division, McGraw-Edison Company, Canonsburg, Pennsylvania.

Pennsylvania has the facilities and the capability to meet all Power Transformer Requirements . . . . . .

- A large, expertly-staffed engineering department with long experience in power transformer design — both core form and shell form.
- The ability to design and construct full-scale test models for proving design characteristics.
- A modernly equipped plant capable of producing and testing the highest rated units contemplated by industry today.
- Handling and loading facilities that permit full utilization of manufacturing, shipping and installation economies.

See preceding 3 pages for other Pennsylvania Autotransformers

PENNSYLVANIA POWER TRANSFORMERS

5703

you can count on quality performance

The stamp of quality which identifies the plants Ebasco designs and builds is also found in the insurance services Ebasco offers. These independent insurance services are devoted exclusively to *your* interests and place at your disposal an experienced staff of consultants who make insurance their full-time work. In addition, these specialists use the technical and consulting personnel of other Ebasco departments when necessary.

Many companies keep up-to-date on constantly changing insurance problems by calling in Ebasco for periodic surveys. It helps them get the most insurance protection at lowest costs.

For information about these services, send for our brochure, "How To Get The Most Out of Your Business Insurance Program," Ebasco Services Incorporated, Dept. M, Two Rector Street, New York 6, New York.

Other Ebasco services include: FINANCIAL AND BUSINESS STUDIES • INDUSTRIAL RELATIONS PENSIONS AND SAFETY • PURCHASING, INSPECTION AND EXPEDITING • RATES AND PRICING RESEARCH • SALES AND PUBLIC RELATIONS • SPACE PLANNING • SYSTEMS, METHODS AND BUDGETS • TAX • VALUATION AND APPRAISAL • WASHINGTON OFFICE

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ground rules
FOR GOOD GROUNDS
FOR RELIABLE, LOW-RESISTANCE GROUND CONNECTIONS THE YEAR 'ROUND . . .
use the proved, low-cost method of deep grounding with Copperweld Sectional Ground Rods.
drive multiple sections —as many as are needed to reach the good conducting soils of constant moisture.
measure resistance after each section is driven, allowing for seasonal variation.
to be sure of permanence be sure to drive Copperweld the only Molten-Welded ground rods.

YOU'RE *Positive* WITH THE **MOLTEN-WELD**

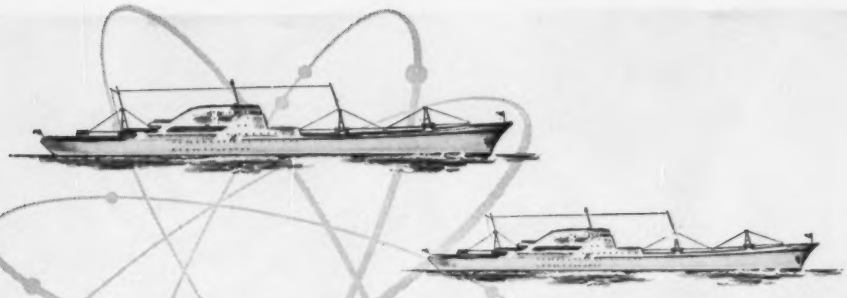
Once it's driven, your ground is in to stay, when it's non-rusting Copperweld. This micro-photograph of the weld area shows how the grains of copper and steel interlock to form a permanent, continuous weld. No other process achieves this inseparable union.

By following these practical ground rules, using Copperweld* Sectional Ground Rods, you can be certain you'll get the very best results from your protective equipment—not only during wet seasons, but throughout the year. There's no better or more economical way to improve line performance, increase safety, and reduce service interruptions.

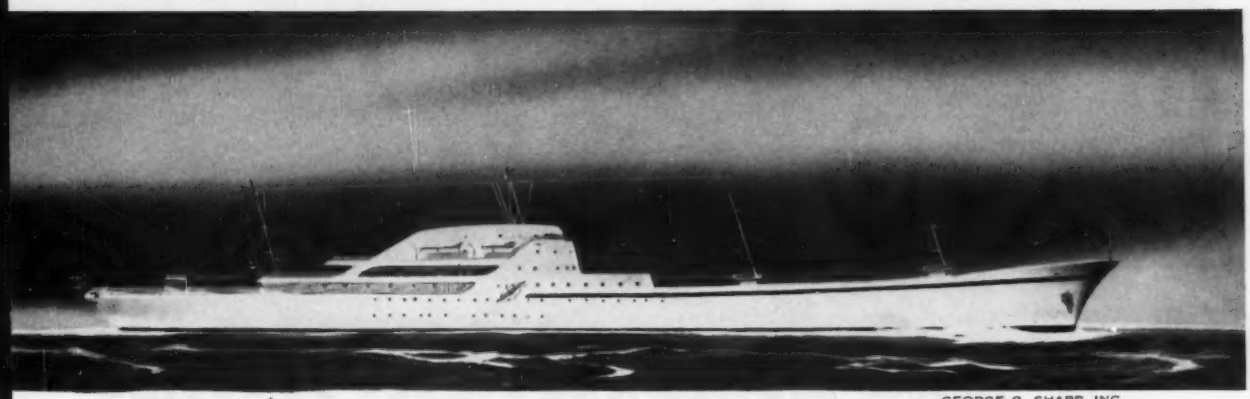
**Trade Mark*

COPPERWELD STEEL COMPANY
WIRE AND CABLE DIVISION *Glassport, Pa.*
For Export: COPPERWELD STEEL INTERNATIONAL COMPANY, New York

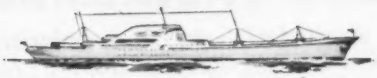
Drive DEEP with Copperweld TRADE MARK **sectional ground rods**



Leading the Way to a Nuclear-Powered Merchant Fleet



GEORGE G. SHARP, INC.



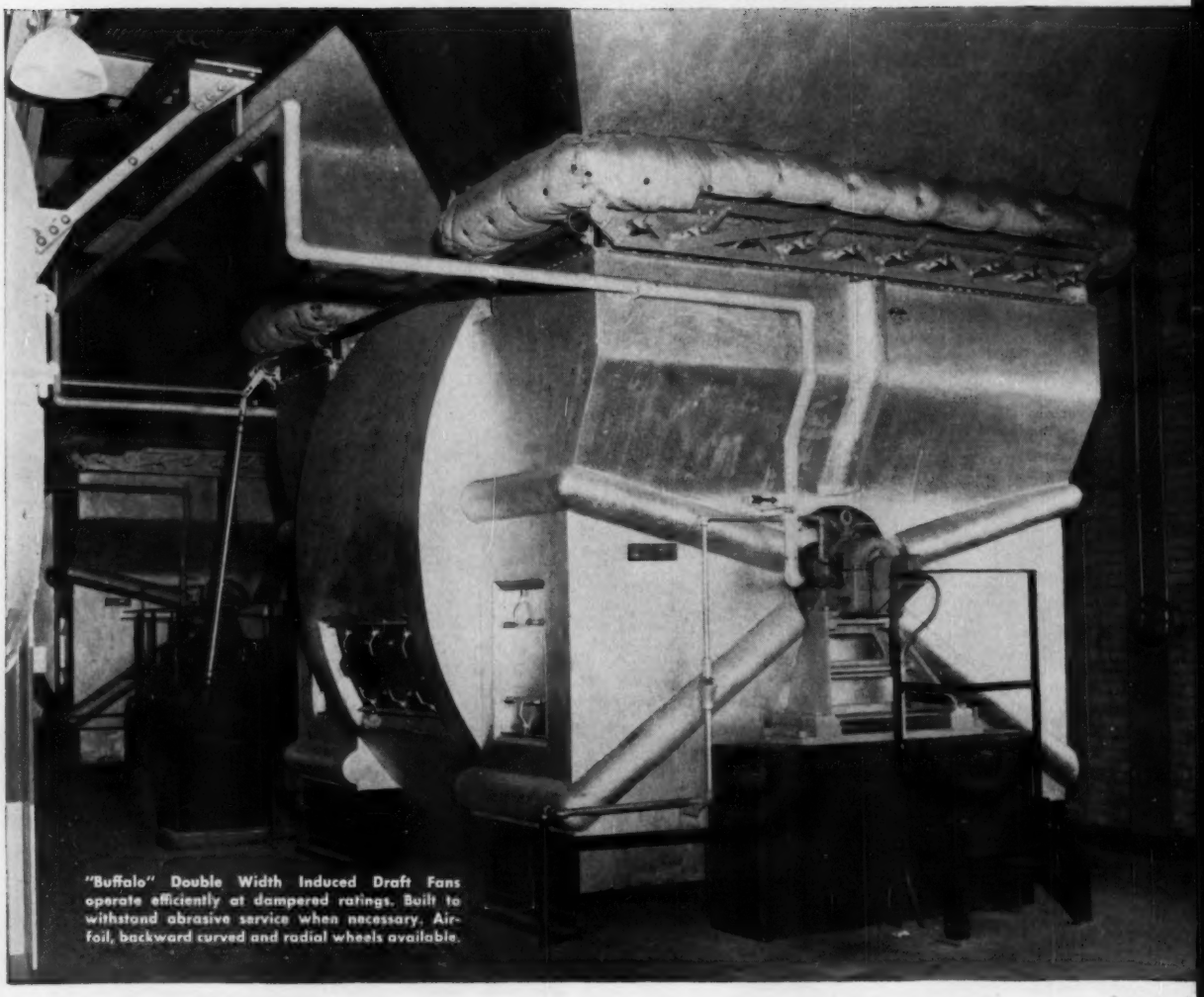
Scheduled to be ready for sailing by 1960, the first nuclear-powered merchant vessel will help to assess the economic feasibility of nuclear power as a means of propelling merchant ships . . . another big step toward putting the power of the atom to work constructively and economically. Designed to steam for 350,000 miles—about 3½ years—on a single loading of nuclear fuel, the single screw ship will have a capacity of 9,000 to 10,000 deadweight tons of cargo plus 60 passengers.

The Contract To Design, Manufacture and Install the complete pressurized water reactor propulsion system for this new vessel has been awarded to The Babcock & Wilcox Company. The advanced reactor, being developed at B&W's Atomic Energy Division at Lynchburg, Va. will utilize fuel elements of low uranium-235 enrichment. The complete propulsion system is being designed to develop a maximum of 22,000 shaft-hp.

In Nuclear Power Development, The Babcock & Wilcox Company comprises a single source for power reactors, propulsion reactors, research reactors, fuel elements, reactor components and experimental reactor development. The designing and engineering of complete nuclear steam generating plants are supported by B&W's long experience in related fields, helping to apply the most recent developments in engineering knowledge to the solution of your problems. The Babcock & Wilcox Company, 161 East 42nd Street, New York 17, N. Y.

G-865

BABCOCK & WILCOX



"Buffalo" Double Width Induced Draft Fans operate efficiently at dampered ratings. Built to withstand abrasive service when necessary. Airfoil, backward curved and radial wheels available.

"Buffalo" AIRFOIL FANS MEET EXACTING

Pacing the airfoil's rise to popularity for mechanical draft service, the "Buffalo" Airfoil offers many unique design and construction

- A completely streamlined inlet and matching wheel flange for completely smooth half-circle entry — no flat spots.
- Extra-wide airfoil blades with tips to full channel width — for extra-deep "bite".

TYPE "BA", the basic wheel design for mechanical draft applications.

TYPE "CA", for conditions of higher pressure and lower capacity.

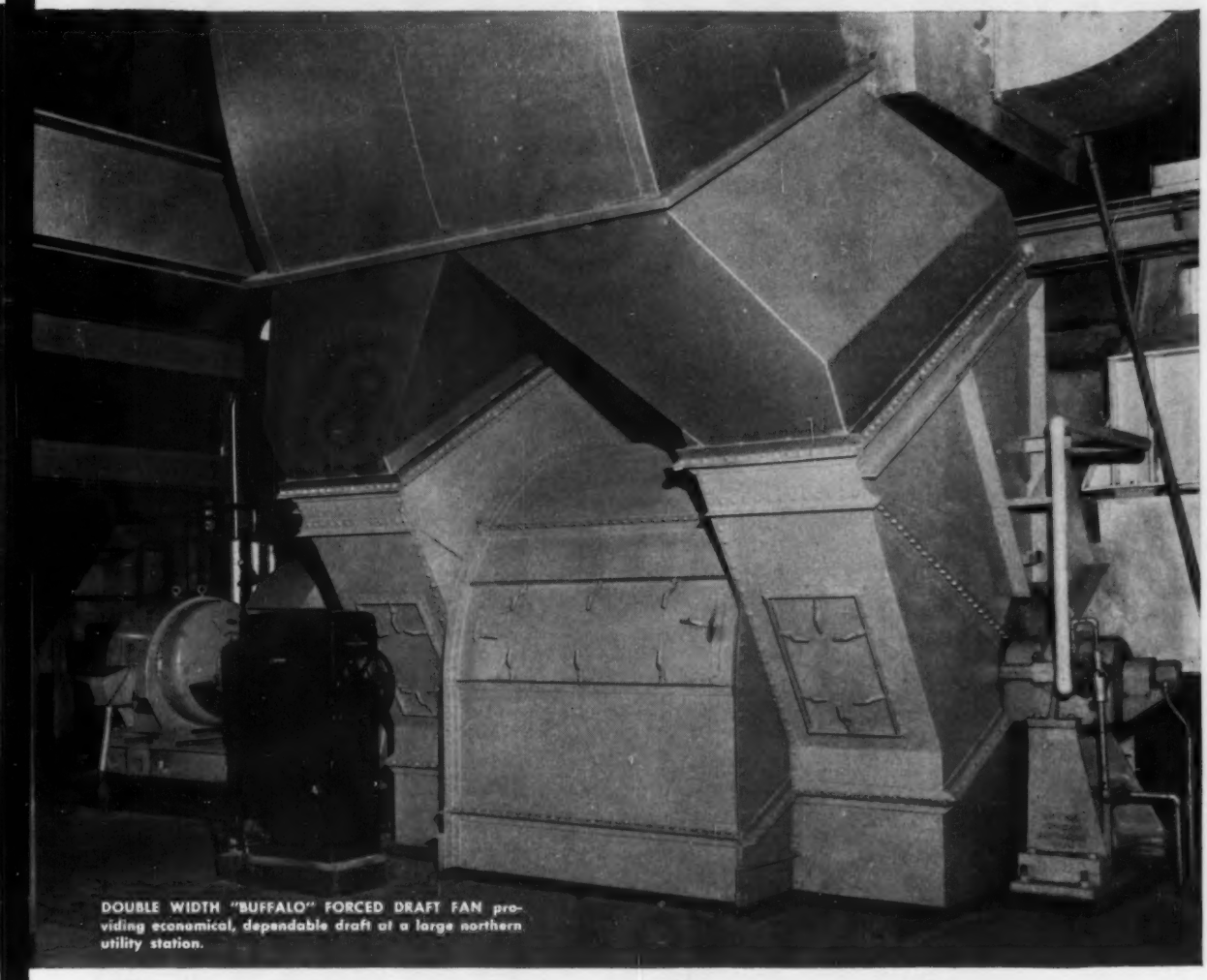
TYPE "AA", for lower pressures and higher capacities.

TYPE "CLM", one of 3 semi-airfoil wheels approaching performance of full airfoil wheels.

THE COMPLETE "BUFFALO" AIRFOIL SERIES TO MATCH ALL SPECIFIC OPERATING CONDITIONS

All wheels variable as to width for exact match of pressure-volume requirements with no sacrifice in efficiency. If you are interested in the finest draft service, write today for Bulletin FD106.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT



DOUBLE WIDTH "BUFFALO" FORCED DRAFT FAN providing economical, dependable draft at a large northern utility station.

MECHANICAL DRAFT REQUIREMENTS

features found in no other fan. By combining modern fan engineering with traditional "Q" Factor* construction, "Buffalo" has given the industry an airfoil fan offering these important features:

- Strength and rigidity in the wheel — massive smoothly curved hub — heavy plate formed flanges welded to blades.
- "Buffalo" divergent outlet reduces outlet turbulence common to fans without such an outlet — provides smooth conversion from velocity to static pressure.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

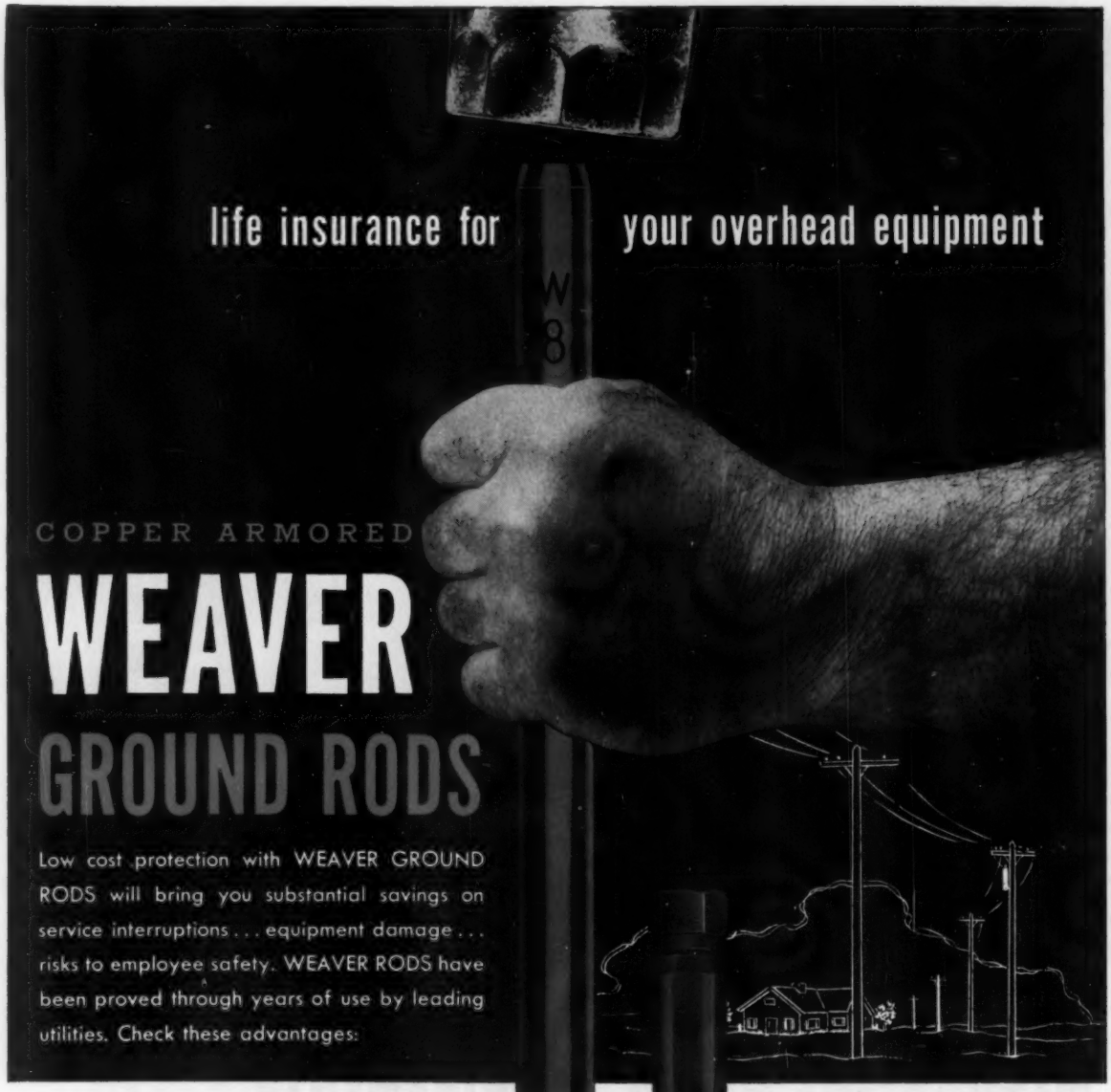
BUFFALO FORGE COMPANY

BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING



COPPER ARMORED

WEAVER GROUND RODS

Low cost protection with WEAVER GROUND RODS will bring you substantial savings on service interruptions . . . equipment damage . . . risks to employee safety. WEAVER RODS have been proved through years of use by leading utilities. Check these advantages:

- **rigid hi-strength steel core**
- **heavy, uniform, non-porous copper coating for corrosion resistance from tip to tip . . . high conductivity**
- **chamfered top . . . no mushrooming**
- **machined point . . . easy driving**

SECTIONAL RODS . . .

for deep grounds to moist soil or to high conductivity strata where installations get added protection from lower ground-to-rod resistance.

FITTINGS . . .

threaded bronze couplings, sturdy steel driving studs . . . fit all standard sectional rods.

SEE YOUR WEAVER WHOLESALER

J. A. WEAVER Company

2110 HOWARD ST. • ST. LOUIS 6, MO.

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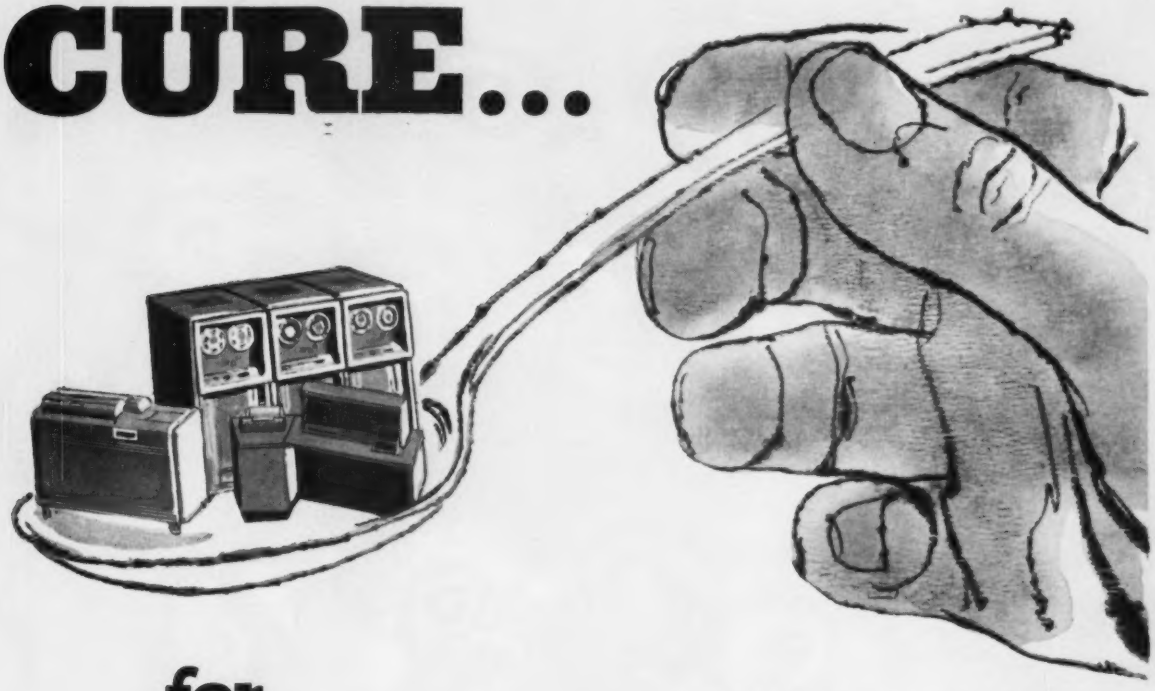
CURE...



for public utility growth problems

• To keep service up . . . and costs down . . . in today's rising tide of public utility growth, more and more companies depend on the speed and accuracy of IBM electronic data processing systems to eliminate growth problems.

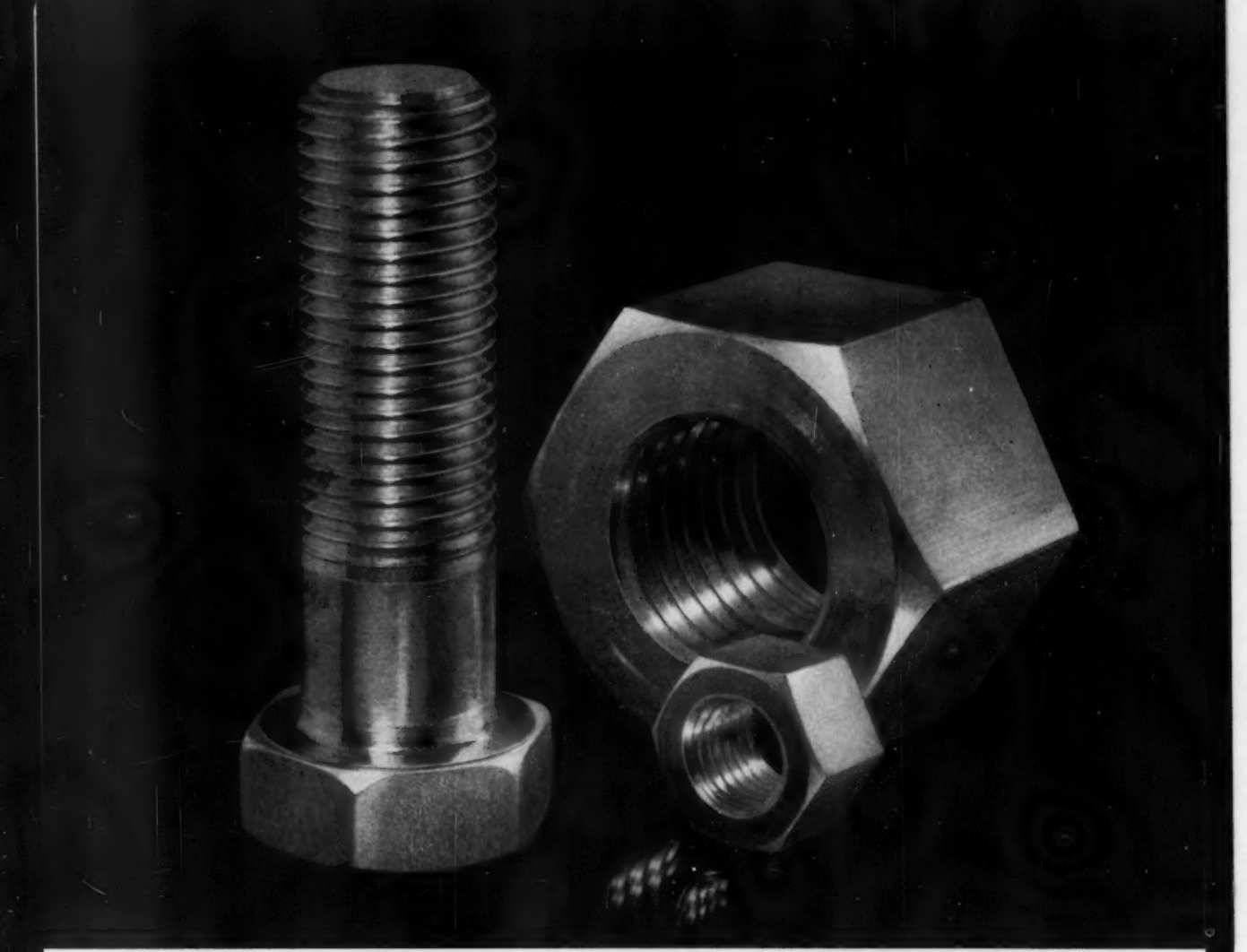
• One large utility company, for example, has already saved some $70,000 on payroll and stock dividend applications through the use of its IBM 705.

• In the face of your growth, too, IBM systems not only maintain the great service tradition of public utilities, but actually smooth out procedures . . . step them up. Moreover, they can solve your complex engineering problems, freeing valuable engineering talent for more creative work. And expanding customer billing, payroll, other routine accounting jobs are done more easily, swiftly, accurately.

• Whether your problems are in accounting *or* engineering, your IBM representative brings the full weight of IBM's 43 years of experience and *proven* performance to bear on them. Why not phone him today? Or write: Public Utilities Department A57, International Business Machines Corporation, 590 Madison Avenue, New York 22, New York.

IBM DATA PROCESSING

- DATA PROCESSING
- ELECTRIC TYPEWRITERS
- TIME EQUIPMENT
- MILITARY PRODUCTS



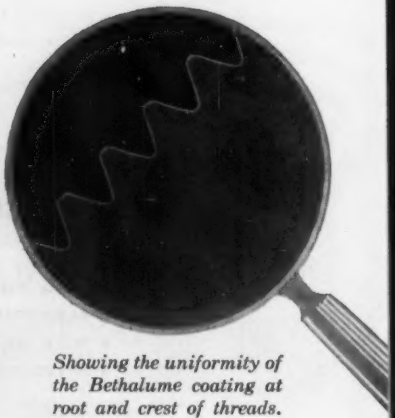
Better Protection Against Corrosion

Fasteners stay on the job for longer periods of time, and in virtually all kinds of atmosphere, when protected against corrosion with Bethalume—Bethlehem's hot-dip coating of pure aluminum.

The Bethalume coating resists corrosion for long periods because it is vastly superior to other types of hot-dip coatings. The Bethalume coating is applied to the base steel by a special technique, providing a corrosion-resistant surface which is unusually uniform over the entire area of the article. As a result, threads are cleaner and sharper than is the case with other hot-dip coatings.

Because of its uniformity, plus the superior corrosion resistance of aluminum, the Bethalume coating has the ability to provide exceptional service just about anywhere—even in high-temperature corrosion applications.

Like to look into the service life of Bethalume-coated fasteners in corrosive atmospheres? If so, just drop a line to the nearest Bethlehem sales office.



Showing the uniformity of the Bethalume coating at root and crest of threads.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

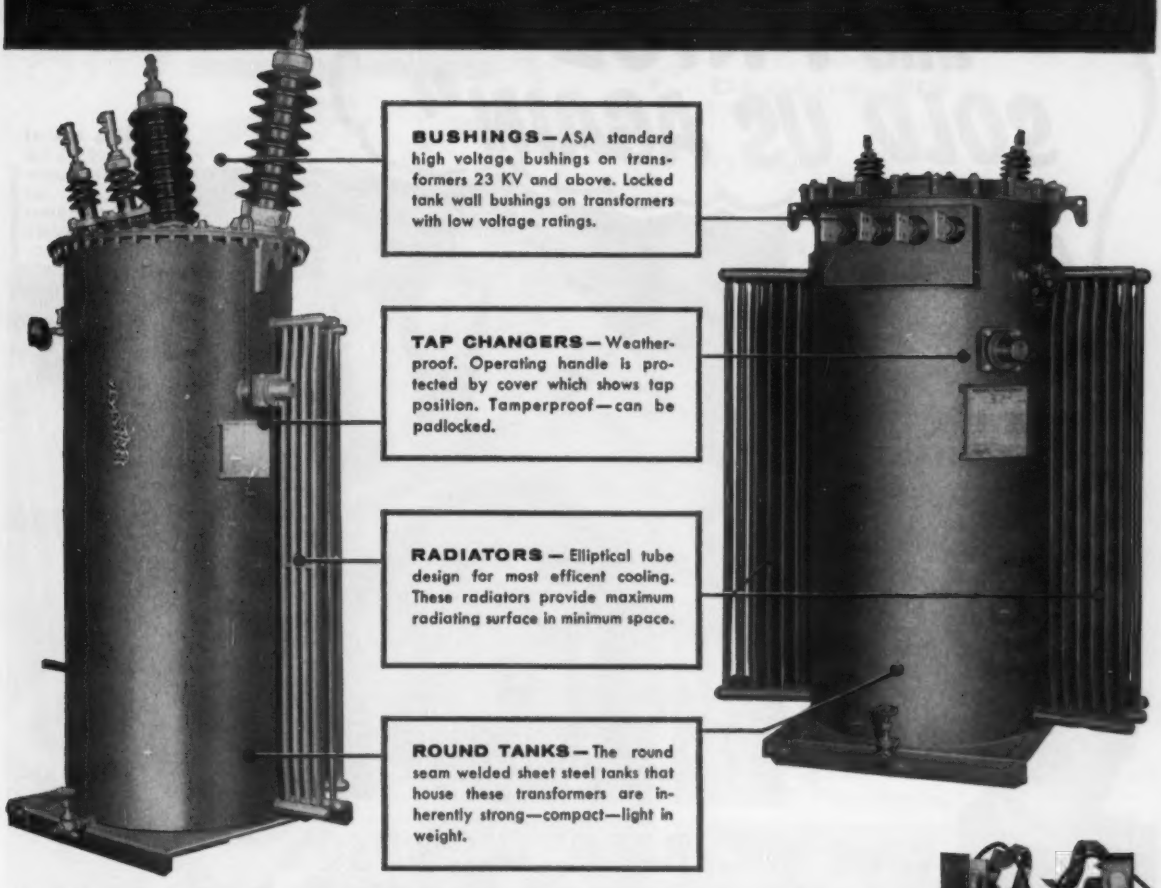
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

Wagner Form W Substation Transformers

are lighter... more compact... easier to handle



BUSHINGS—ASA standard high voltage bushings on transformers 23 KV and above. Locked tank wall bushings on transformers with low voltage ratings.

TAP CHANGERS—Weatherproof. Operating handle is protected by cover which shows tap position. Tamperproof—can be padlocked.

RADIATORS—Elliptical tube design for most efficent cooling. These radiators provide maximum radiating surface in minimum space.

ROUND TANKS—The round seam welded sheet steel tanks that house these transformers are inherently strong—compact—light in weight.

Ratings through 500 kva, voltages to 69,000

Wagner Form W Transformers are available for every requirement of modern distribution systems—500 kva smaller, 69 kv and below.

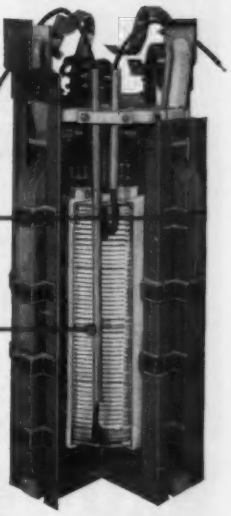
These Wagner Transformers are designed with the Form W core and coil assembly that requires less size and weight per kva—permits compact, light weight transformers that are easy to handle and install.

Form W Transformers will meet your distribution system requirements. Bulletin TU-141 gives full information. Write for your file copy today.

FORM W CONSTRUCTION

CORES are of cold-rolled, oriented grain steel, assembled through and around the coils. In sizes from 250 to 500 kva, there are 4 core sections spaced 90° apart.

WINDINGS... high voltage and low voltage coils are wound on insulating cylinders of high mechanical and dielectric strength, with windings best suited to each transformer's rating, voltage and current.



Wagner Electric Corporation
SERVING INDUSTRY SINCE 1891

TST-10

BRANCHES AND DISTRIBUTORS
IN ALL PRINCIPAL CITIES

Wagner Electric Corporation
6456 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

"PERFORMANCE and PRICE SOLD US AGAIN"

Inspecting one of two 7500/9375 kw Brown Boveri turbo-generators at McWilliams Power Plant, Alabama Electric Coop., Inc.

says MR. BASIL THOMPSON

Manager, Alabama Electric Cooperative, Inc., Andalusia, Ala.

THE outstanding performance record of these Brown Boveri Turbo-Generator sets is typical. Day-in and day-out economies and dependable, trouble-free operation at higher efficiencies, when added to low initial cost, account for the world-wide acceptance of Brown Boveri equipment.

You owe it to yourself to get the facts. *Write today!*

"WE ORDERED A THIRD BROWN BOVERI TURBO-GENERATOR SET because an inspection of the two we now have operating revealed their excellent condition after 864 days of continuous operation. . .and because **WE SAVED** more than $345,000 (**over 30%**) on the new 22 MW preferred-standard unit."

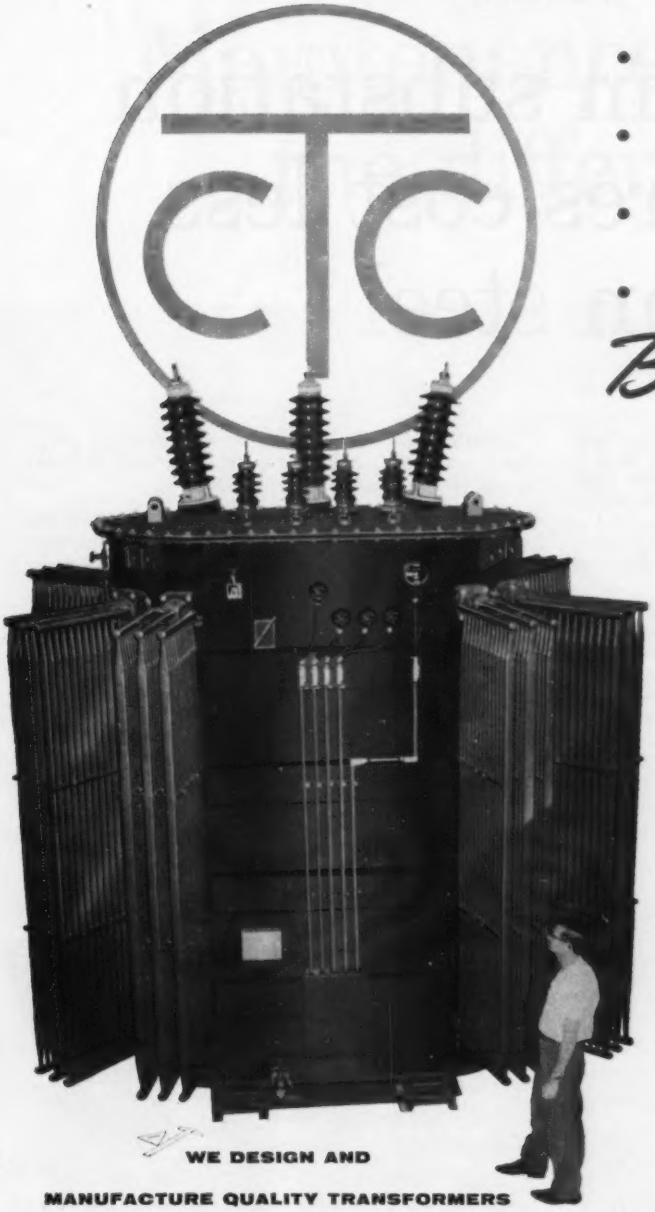
BROWN BOVERI CORPORATION

19 RECTOR STREET • NEW YORK 6, N. Y.

BROWN BOVERI

Atlanta, Ga. • Birmingham, Ala. • Boston, Mass. • Buffalo, N. Y. • Chicago, Ill. • Cleveland, O. • Dallas, Tex. • Denver, Colo. • Detroit, Mich. Hamilton, O. • Jacksonville, Fla. • Kansas City, Mo. • Knoxville, Tenn. • Miami, Fla. • Minneapolis, Minn. • New Orleans, La. • New York, N. Y. Pasadena, Cal. • Pittsburgh, Pa. • Portland, Ore. • Roanoke, Va. • San Francisco, Cal. • San Juan, P. R. • Syracuse, N. Y. • Tucson, Ariz.

CENTRAL POWER TRANSFORMERS



WE DESIGN AND
MANUFACTURE QUALITY TRANSFORMERS
—NOTHING ELSE

- **Economical**
- **Dependable**
- **Quiet**
- **Long Lasting**

Because they are

Precision Engineered
Precision Built
Precision Tested

Here at CENTRAL we specialize in the manufacture of only one product—TRANSFORMERS!

ALL of our engineering knowledge
ALL of our modern equipment
ALL of our combined skill and effort

are concentrated on the building of uniformly high-quality DISTRIBUTION and POWER Transformers.

The key word to describe our production process is PRECISION. As a result, we are able to maintain CONSTANT CONTROL of quality, every step of the way. Most of the so-called "extras" in quality are standard in CENTRAL Transformers.

And, because we are geared for specialized production, CENTRAL Transformers can be delivered to the customer QUICKER.

Is it any wonder that CENTRAL Transformers more and more are finding preference among discriminating buyers?

Central
TRANSFORMER CORPORATION

PINE BLUFF, ARKANSAS
Telephone JEfferson 4-5332

Sales Offices in Principal Cities

NEMA

FACT:

Aluminum substation structures cost less than steel

The four graphs show comparative costs of large and small aluminum and steel substation structures in corrosive industrial and marine atmospheres. Note that while aluminum's original cost is slightly higher than that of steel, the favorable cost differential of steel is eaten up by high maintenance costs in only 3 years for small structures, 10 years or less for large structures.

Since aluminum requires no maintenance, its original cost is its real cost. But steel's cost does not end with its original cost . . . steel's maintenance cost keeps mounting—for 5 years, 10 years, 20 years, as long as the structure stands.

Steel substations in corrosive areas require two coats of paint every five years to prevent rust and corrosion. Often, the structure must be re-galvanized, which means it must be disassembled. Costs of rehabilitating a steel structure can run as high as 5 to 12 cents per pound of structure.

On the other hand, aluminum substation structures can't rust, resist corrosion, never need painting—maintenance costs are eliminated.

Aluminum's natural affinity for oxygen results in a thin, hard oxide surface film which resists highly corrosive industrial and marine atmospheres. The cost of painting, made even greater by power interruptions, is eliminated.

Find out now how aluminum can meet your substation specifications more efficiently and at less cost. Kaiser Aluminum's highly experienced engineers are available, without charge or obligation, to assist you with any substation problem. For immediate attention, contact the Kaiser Aluminum sales office listed in your telephone directory—or write: *Kaiser Aluminum & Chemical Sales, Inc., 919 N. Michigan Ave., Chicago 11, Illinois.*

New Booklet Gives Complete Information

Kaiser Aluminum's new 48-page booklet, *"Aluminum Substation Structures"* fully explains the many advantages of aluminum and offers complete design information—including most economical usage, recommended alloys, substation details and extensive design formulas, tables and diagrams. To get this informative free booklet write: *Kaiser Aluminum & Chemical Sales, Inc., Industry Development Department, 919 N. Michigan Ave., Chicago 11, Illinois.*

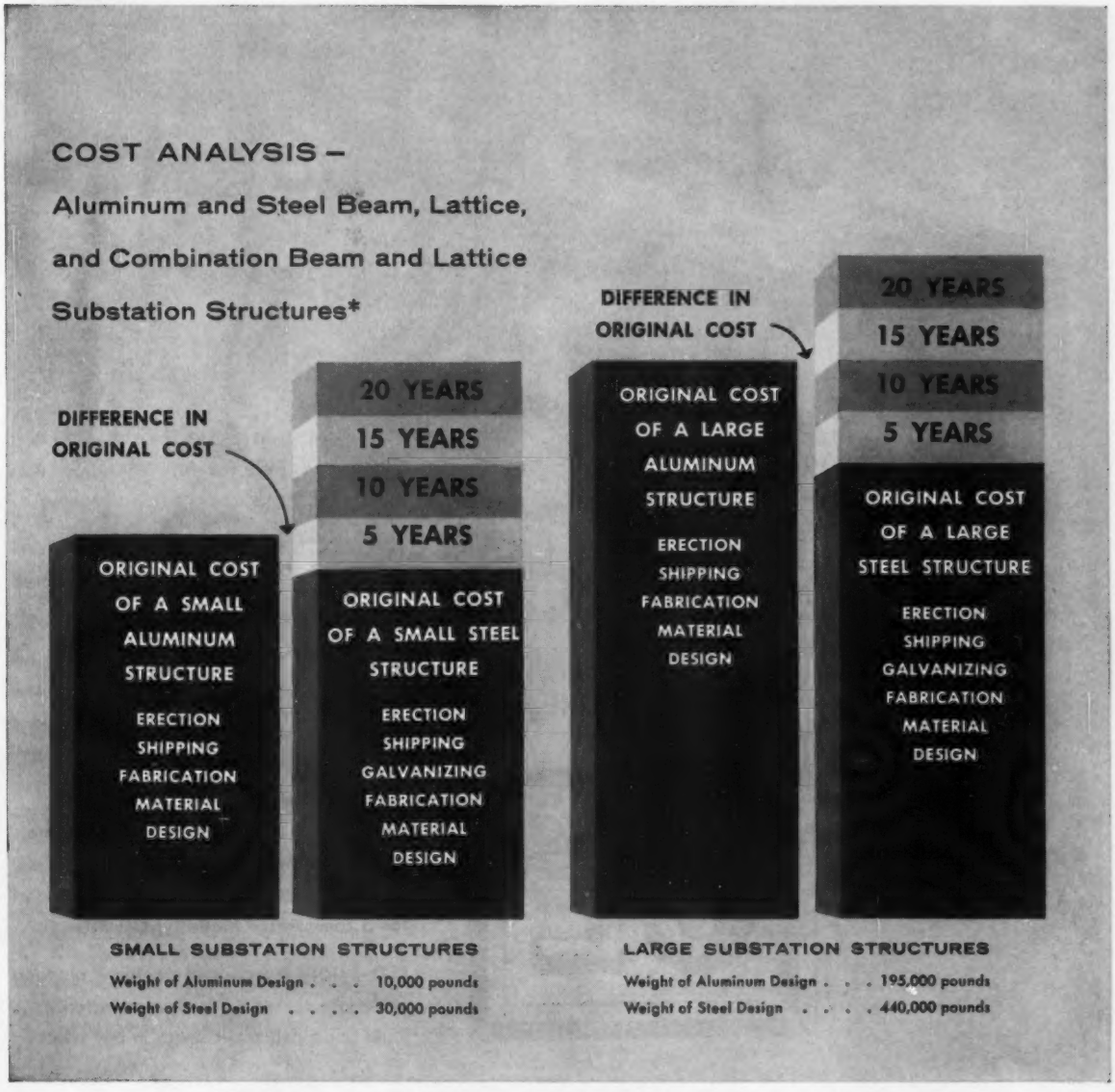
KAISER Aluminum

THE BRIGHT STAR OF METALS

While Kaiser Aluminum does not fabricate and erect substation structures, we do supply leading erector-fabricators with high quality American standard extruded angles, channels and "I" beams. Call your local Kaiser Aluminum sales office for immediate attention.

PROOF:

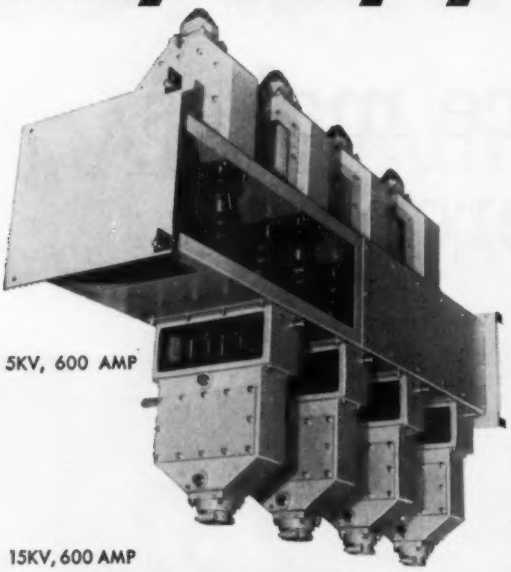
Maintenance makes the difference



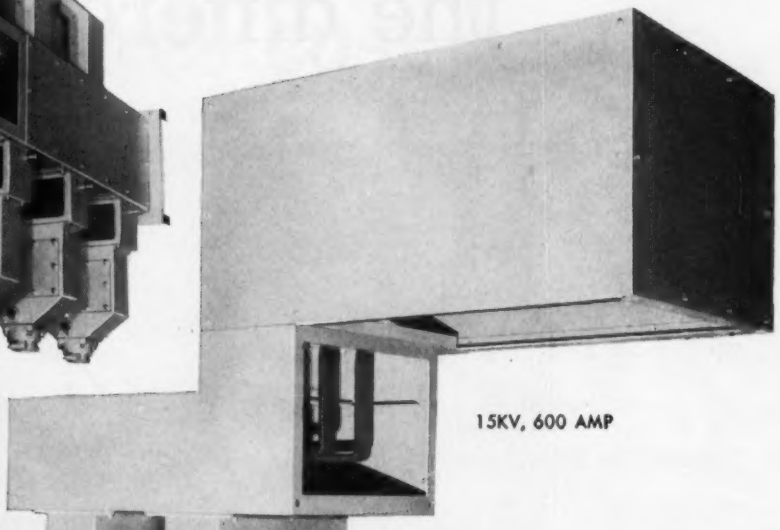
*Based on an average of maximum and minimum cost figures obtained from utilities, fabricators and electrical equipment manufacturers across the country.

Any way you look at it!

3E ISO-DUCTS are the most compact, practical switching centers

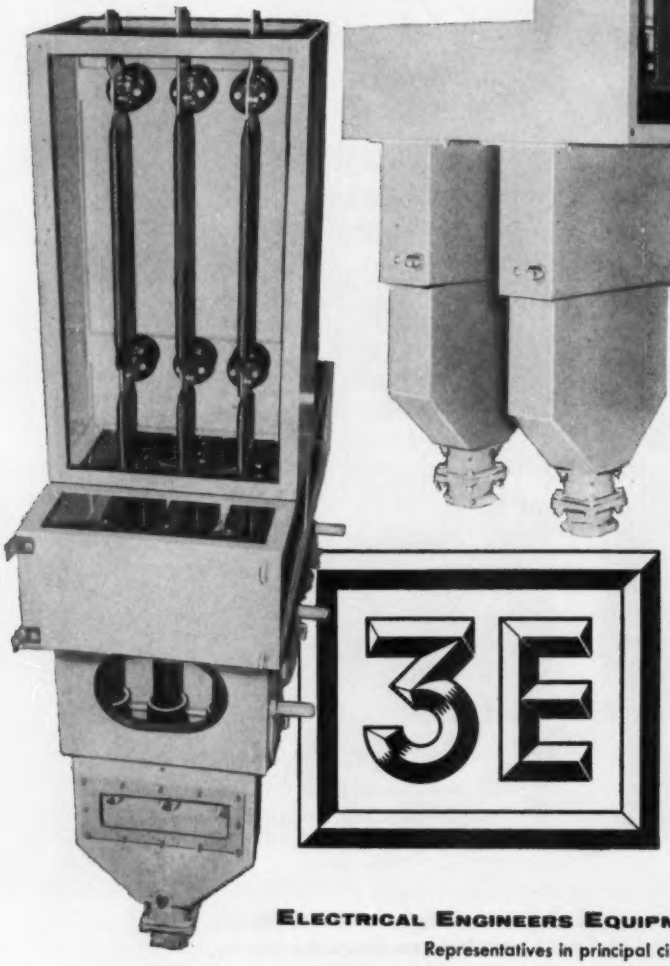


5KV, 600 AMP



15KV, 600 AMP

15KV, 600 AMP



ISO-DUCTS are Isolators, with Bus Ducts arranged for future extension in either direction.

ISO-DUCTS are safe. The bus and working parts of the Isolator are fully enclosed at all times for complete protection.

ISO-DUCTS are versatile. 3E design allows for any number of Isolators and pothead combinations. Also, the Isolators and Potheads can easily be interchanged if an arrangement change is necessary.

ISO-DUCTS save space. The Isolators straight line telescoping action performs disconnect operations using ⅓ the space needed for a comparable blade type switch.

ISO-DUCTS functional design is pleasing to the eye . . . ideal for modern factories . . . looks good and saves space in any plant.

ELECTRICAL ENGINEERS EQUIPMENT CO. • Melrose Park, Illinois

Representatives in principal cities — in Canada by Powerlite Devices, Ltd.

NEW MOTOROLA T-POWER® 2-WAY RADIO

Transistorized Power Supply for both receiver and 25-watt transmitter

Long Life Transistors Replace the Vibrator . . .
Reduce Maintenance and "Down-Time"

Already famous for the lowest maintenance and operating costs in the 2-way mobile radio field, Motorola mobile radio is an even better investment now—with the T-POWER unit. The vibrator is gone! . . . replaced by rugged long-life transistors. Gone, too, is the problem of frequent vibrator replacement. Here is a mobile radio with an all-electronic power supply.

New Mounting Flexibility with Plug-In Control Head
. . . Same Basic Unit can be Used for Front or Trunk Mounting

With the T-POWER radio, you are no longer restricted to one type of mounting. Install the complete radio, with drawer unit and plug-in control head, for under-dash mounting. For rear mounting the same basic drawer unit can be installed in the trunk and connected by cable to a dash-mounted control head. And—the same basic drawer unit can be interchanged with the equivalent Motorola Twin-V trunk mount radio models operated from a 12-volt negative ground source.

T-POWER radio is another example of Motorola's continuing leadership in the practical application of transistors in mobile radio. Other tested and proved transistorized products include the Dynamic Microphone and Power Voice Speaker.

Get all the facts.—Write now for literature with complete information.

MOTOROLA Communications & Electronics, Inc. · 4501 Augusta Blvd., Chicago 51, Illinois · A Subsidiary of Motorola Inc.

Instrumentation News

• *News of instrumentation and automatic control in modern industry* •

BRISTOL EXPANDS

Steps Up Instrument Service With New Branch Factories in Los Angeles and Houston

5 Branch Factories Plus 44 Service Centers Now Speed Instrument Service Throughout U. S. and Canada.

The new branch factories represent a major expansion of existing instrument repair and service facilities in these cities, and surrounding areas. The new branch factories are staffed with thoroughly trained Bristol field engineers and technicians and have all the equipment necessary for manufacturing standard instruments and for completely rebuilding and calibrating any Bristol instrument. (Every such factory-reconditioned instrument carries a "new" guarantee.)

The Los Angeles and Houston branch factories bring the total number of branches to five—others being located at San Francisco, Chicago and Toronto (Bristol Company of Canada, Ltd.).

The new Los Angeles branch factory, located at 6800 East Acco Street, will bring top notch instrument service to the rapidly growing West Coast electronics and aircraft industries. The Houston branch will be of particular interest to instrument users in this Southwestern center of the petroleum and petrochemical industries.

NEW PITTSBURGH HEADQUARTERS

PITTSBURGH, PA.—As part of its overall expansion, The Bristol Company announced a new and enlarged branch office headquarters at 2250 Noblestown Road, this city.

The new office will augment the already outstanding instrument service Bristol has given customers in this area since establishment of the first Bristol branch office here in 1906.

New Los Angeles Bristol Branch Factory

New Pittsburgh Headquarters

New Houston Branch Factory

"ON-THE-SPOT SERVICE" for users everywhere

WATERBURY, CONN.—The recent opening of new branch factories and offices will step up on-the-spot services for Bristol instrument users, wherever located.

Bristol customers services begin long before an instrument is purchased and continue long afterward. Bristol field and application engineers, throughout the U. S. and Canada, are available to recommend equipment best suited to your job.

NO AXES TO GRIND

You are assured of an unbiased recommendation because Bristol makes almost every kind of instrument – full size, miniature, electronic, pneumatic, electric, mechanical. Bristol process instrument specialists are ready to advise you on up-to-the-minute control systems for new tough or unusual processes.

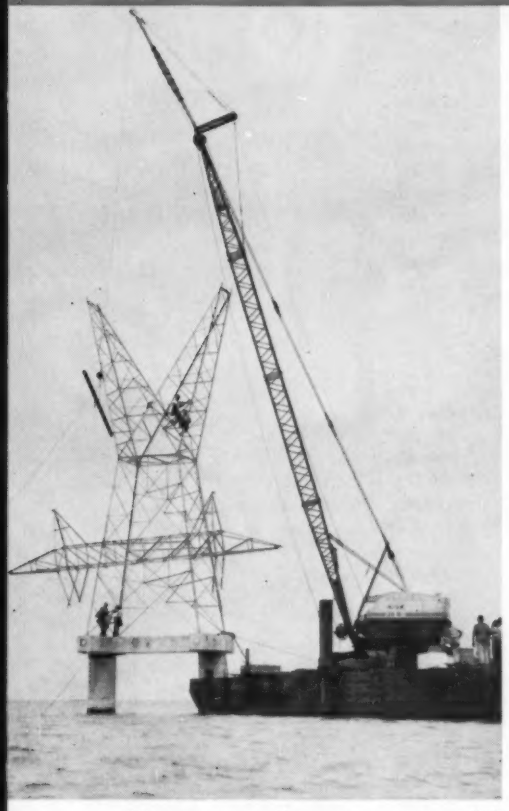
After purchase, you have available on short notice—often within a few hours—a nationwide staff of factory-trained, widely experienced Bristol service engineers. For a reasonable rate, they install, check, adjust and inspect Bristol instruments in your plant. You can arrange to have a Bristol service engineer call at regular intervals to keep equipment in top operating condition.

Complete factory reconditioning is now available at 5 factories: San Francisco, Los Angeles, Chicago, Houston, the main factory at Waterbury, and the Bristol Company of Canada, Ltd., Toronto. Write for full particulars on Bristol instruments or service. The Bristol Company, 116 Bristol Road, Waterbury 20, Conn. 7.25

BRISTOL *TRAIL-BLAZERS IN PROCESS AUTOMATION*

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

Louisiana Power & Light Company
BUILDS 230-KV LINE ACROSS LAKE PONTCHARTRAIN



After tower erection, crossarms were left attached to lower portion of tower until center conductor was raised to crotch of tower and laid temporarily in wooden trough.

Double-circuit part of Snake Farm-Bogalusa (before installation of second circuit) line as it enters Lake Pontchartrain. Special ACSR conductor was used on 75-mile long line.

Towers rest on concrete piles driven 60 feet into muck

On one hand lay the uncertain problems offered by a route through the bayous and marshes around Lake Pontchartrain.

On the other hand were the known problems of building the line through the lake itself.

Louisiana Power & Light Company chose the lake route for its new 230-kv transmission line. The 75-mile line from Snake Farm substation near New Orleans to Bogalusa substation on the high land across Lake Pontchartrain was completed in September. Thirty-five miles of it ran through the lake.

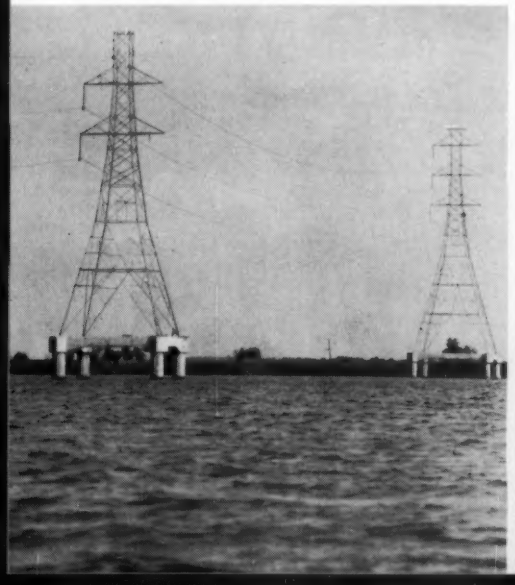
Among the line's unusual features are special strandings of ACSR conductor, the special concrete piles driven as much as 60 feet into the muck to reach a solid foundation, the excellent counterpoise system set up with the help of the lake's salt water, and the need for protection against both hurricanes and lightning during the area's annual 75 storm days.

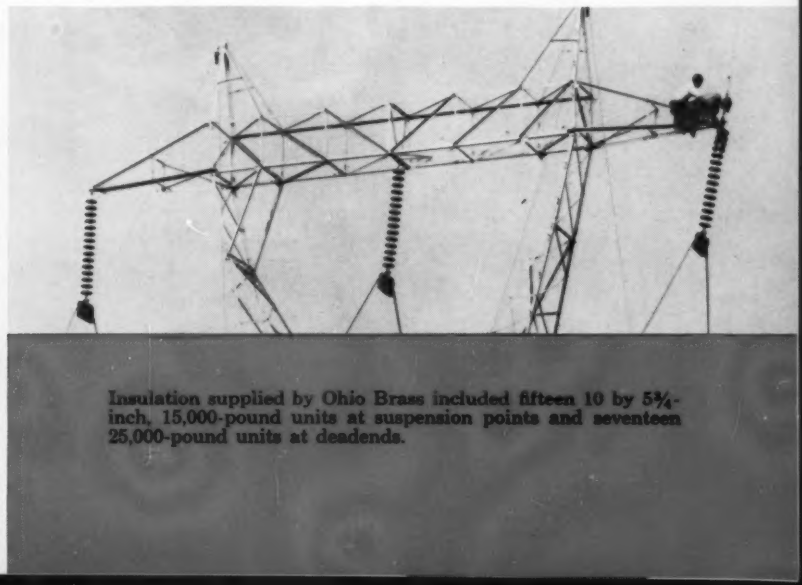
The insulation supplied by Ohio Brass included fifteen 10 by 5¾-inch units at suspension points, and seventeen 25,000-pound units at deadend and angle towers.

Once again when service requirements are likely to be severe, the choice of insulators is O-B. This has been true through the years . . . on the long spans, in the mountains, in the heavy storm areas of the world . . . that the majority of insulators are supplied by Ohio Brass. You'll find them everywhere that "something extra" is required of an insulator.

Ohio Brass

OHIO BRASS CO. MANSFIELD, OHIO





Insulation supplied by Ohio Brass included fifteen 10 by 5¾-inch, 15,000-pound units at suspension points and seventeen 25,000-pound units at deadends.

1.

3.

2.

1. Since there is no need to interrupt winding operation to insert contact tabs, the active dielectric in Varex elements is never touched, not even by gloved hands. The winding room is air conditioned.

2. Every element is checked electrically with DC voltage to insure freedom from shorts or other faults.

3. When elements, secondary insulation and other internal parts are handled, the hands always wear white gloves.

4. White-gloved hands guide the pack assembly into the metal case. The best protection against impurities is to keep them out in the first place.

5. Varex capacitors are dried by carefully controlled combination of heat and vacuum that evacuates them to the low micron range.

PURITY...

VAREX CAPACITORS

GET THE WHITE-GLOVE TREATMENT

PURITY is a way of life in the Varex capacitor plant. Everything that goes into Varex gets the white-glove treatment, figuratively and literally, since one of the best ways to guard against capacitor failure is to use pure materials and to keep them uncontaminated during manufacture.

Incoming insulating paper, aluminum foil and askarel—the real insides of a capacitor—get a complete series of tests to confirm their physical, chemical and electrical characteristics and check their purity. The askarel is again purified and degasified just prior to use, right in the O-B capacitor plant.

Provisions for purity are inherent in the Varex design. For example, the method of cooling elements, with a foil extended at either edge also contributes to the elements' freedom from contamination. It means there need be no interruption of the winding process to insert contact tabs in the element. As a result, the active dielectric is never touched, not even by a white-gloved hand! Winding is done in an air-conditioned room. When the outside of the element, the secondary insulation and other internal Varex components are handled, the hands always wear white gloves.

Before the askarel impregnant goes into the capacitor, the unit is thoroughly and rigorously vacuum-dried to a low micron range, to remove gases and moisture.

As a final safeguard, a power factor measurement is made with the unit operating at full-rated 60-cycle voltage. But we believe the best protection against impurities is to keep them out in the first place. That's why Varex capacitors get the white-glove treatment!

Ohio Brass

4.

5.

THIS NEW UNIVERSAL CLAMP HELPS YOU MAKE GOOD DEADENDS FAST

spring holds keeper open during forming and bending . . .

Using the new 88500 O-B Universal clamp is simplicity itself. A special spring clip holds the keeper open while the conductor is bent and formed. Then just tighten the nuts after the conductor is in place.

Made of galvanized malleable iron, this new clamp offers several other advantages. All work can be done from one side. There are no loose nuts, washers, bolts, or keeper pieces. There is no need for holding and aligning the keeper, since the clamp automatically stays in alignment. Holding strength is high, exact values depending on the size and condition of the conductor. Grooves in the clamp are designed so that the jumper is separated from the taut span cable, to eliminate all possibility of abrasion.

It's easy to see how the O-B Universal clamp will make deadending simpler and cheaper in any distribution system. It fits all conductors in the range of sizes from .20 to .50 inches in diameter. The next time you order universal clamps make sure you specify the new O-B Universal.

Ohio Brass

OHIO BRASS CO. MANSFIELD, OHIO

*GraybaR Since 1869 *REG. U.S. PAT. OFF. Distributed by *GraybaR ELECTRIC COMPANY

4766-H

MEN RESPONSIBLE FOR

POWER DISTRIBUTION KNOW...

IF IT'S PARANITE IT'S RIGHT!®

From Power to Control Cable...

Cable specified for utility applications must provide dependable performance to the highest degree. That's why more and more engineers are saying—If It's Paranite It's Right!® Paranite cable is engineered to perform in excess of your most rigid requirements. Super-Pararite® butyl rubber insulations have been developed to withstand special conditions in your area. Copper or aluminum bare or weatherproof cables—ACSR or line wire (formerly products of Midland Wire Corporation) are available.

PARANITE WIRE AND CABLE

DIVISION ESSEX WIRE CORPORATION

FORT WAYNE 6, INDIANA

MANUFACTURING PLANTS: *Birmingham, Ala.; Anaheim, Calif.; Jonesboro, Ind.; Marion, Ind.; Tiffin, Ohio

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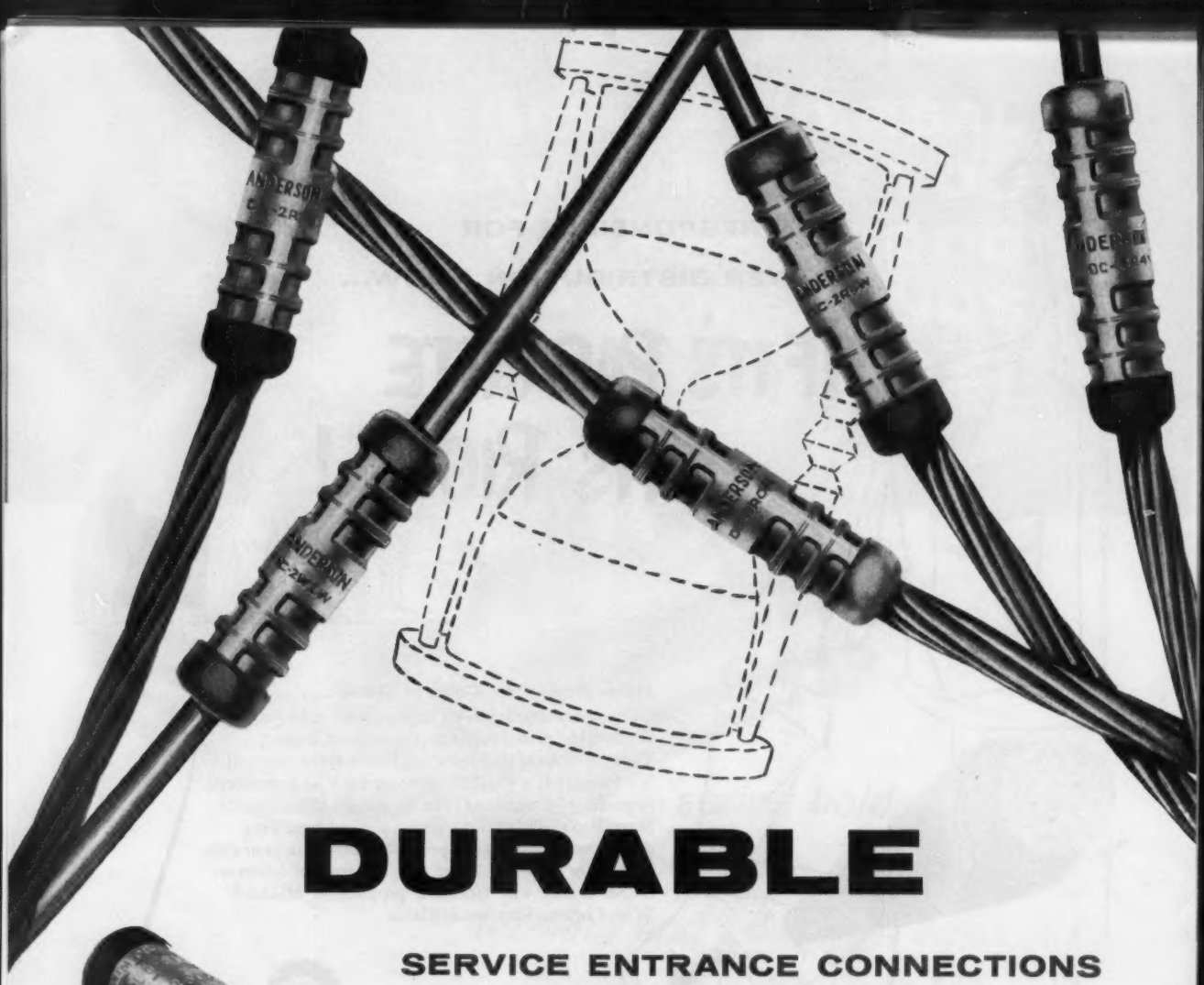
Upper Darby (Philadelphia,) Pa.
Phoenix, Arizona
Rochester, New York
*Saint Louis, Missouri
*San Francisco, California
Springfield, Illinois



DURABLE

SERVICE ENTRANCE CONNECTIONS with ANDERSON DURA-CRIMP COMPRESSION SLEEVES

High conductivity! Quick, simple and easy installation!
Compact and neat! Wide range of conductor combinations!

Anderson Dura-Crimp Compression Sleeves are plainly marked to show (1) die size, (2) die press area, (3) catalog number and (4) complete cable size application. 5/8" O.D. line consists of 17 sizes to accommodate all combinations of Aluminum, ACSR and Copper conductors from #8 AWG to 1/0 AWG. 1/2" O.D. line, 14 sizes for all combinations of Aluminum, ACSR and Copper conductors from #8 AWG to #2 AWG.

Caps, color coded to indicate cable size, are easily removed or punctured by cable.

Anderson's exclusive inhibitor increases conductivity and pull-out strength. The inhibitor's correct distribution in both grooves is assured by a solid, built in center, which also insures correct cable length in each groove and prevents direct cable contact.

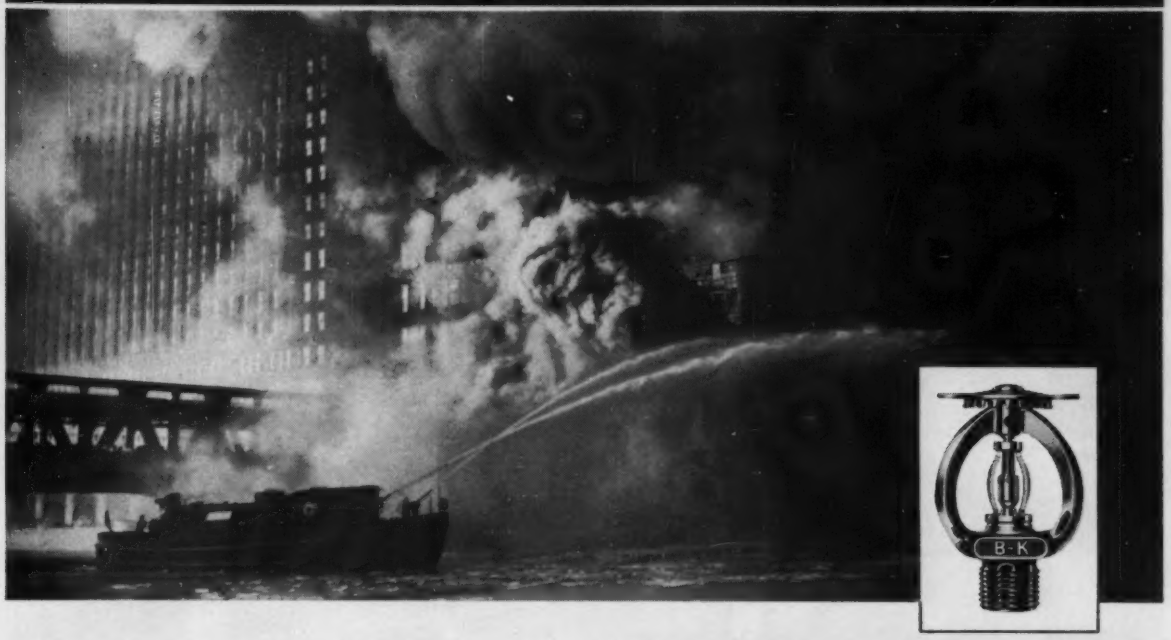
Contact your ANDERSON Representative for complete details . . . or write to our home office.

Aluminum & Bronze POWER CONNECTORS • CLAMPS • FITTINGS • ACCESSORI
for SUBSTATION • TRANSMISSION • DISTRIBUTION

ANDERSON ELECTRIC

CORPORATION
BIRMINGHAM 1, ALABAMA

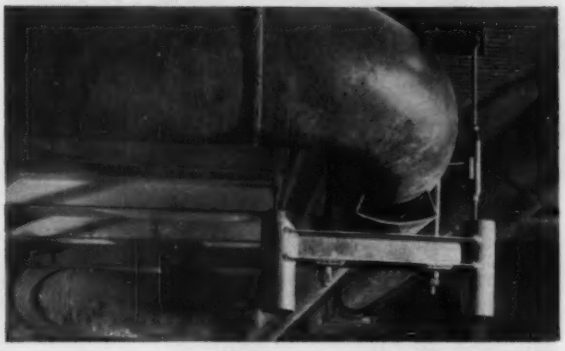
BLAW-KNOX has what it takes—to provide these products and services



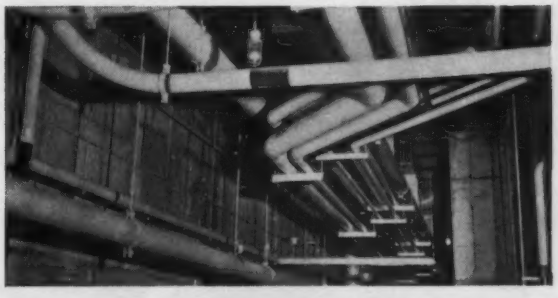
A Blaw-Knox automatic sprinkler system could have prevented this disastrous fire. Each year a serious fire strikes one out of seven manufacturing firms in this country. And out of every 100 firms who lose their records in a fire, 43 never reopen for business. So why take any chances.

Blaw-Knox engineers, fabricates and installs automatic sprinkler systems that are always alert to detect, confine and quench a fire at its origin. Qualified engineers custom-design systems that meet individual requirements—and fulfill all insurance standards and municipal codes. A Blaw-Knox automatic sprinkler system pays for itself in a few years through savings in reduced insurance premiums.

Let a Blaw-Knox fire-protection engineer study your needs, submit a layout and estimate, and tell you how you can pay for the system on our lease or deferred payment plan. For more complete information, write for Bulletin No. 2426—"Fire Can Destroy Your Business."



Blaw-Knox trapeze functional spring hangers, with the patented internal swivel action, support power piping in new generating station. Our experienced engineers are available to both design and make recommendations for your hanger requirements. For further information, send for Catalog No. 54.



High temperature, high pressure oil tunnel piping in large steel mill is typical of many piping systems prefabricated and erected by Blaw-Knox. Experienced piping engineers, modern shop facilities and a new Blaw-Knox digital computer method for fast, accurate calculation of piping stresses are available to you. Let us know your requirements and we will provide the service you need. For additional information, write for Bulletin No. 2443—"Piping for Industry."

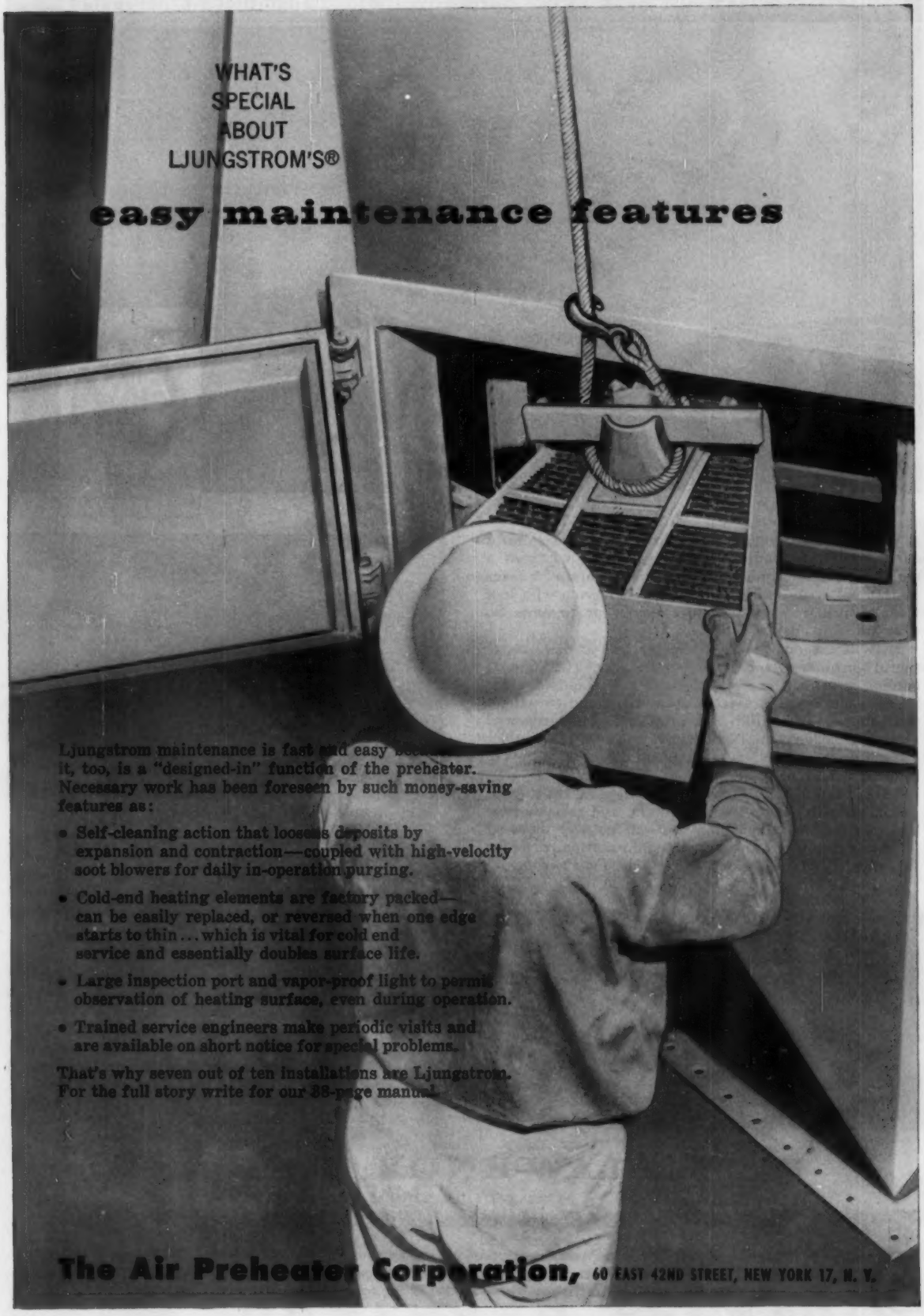
BLAW-KNOX

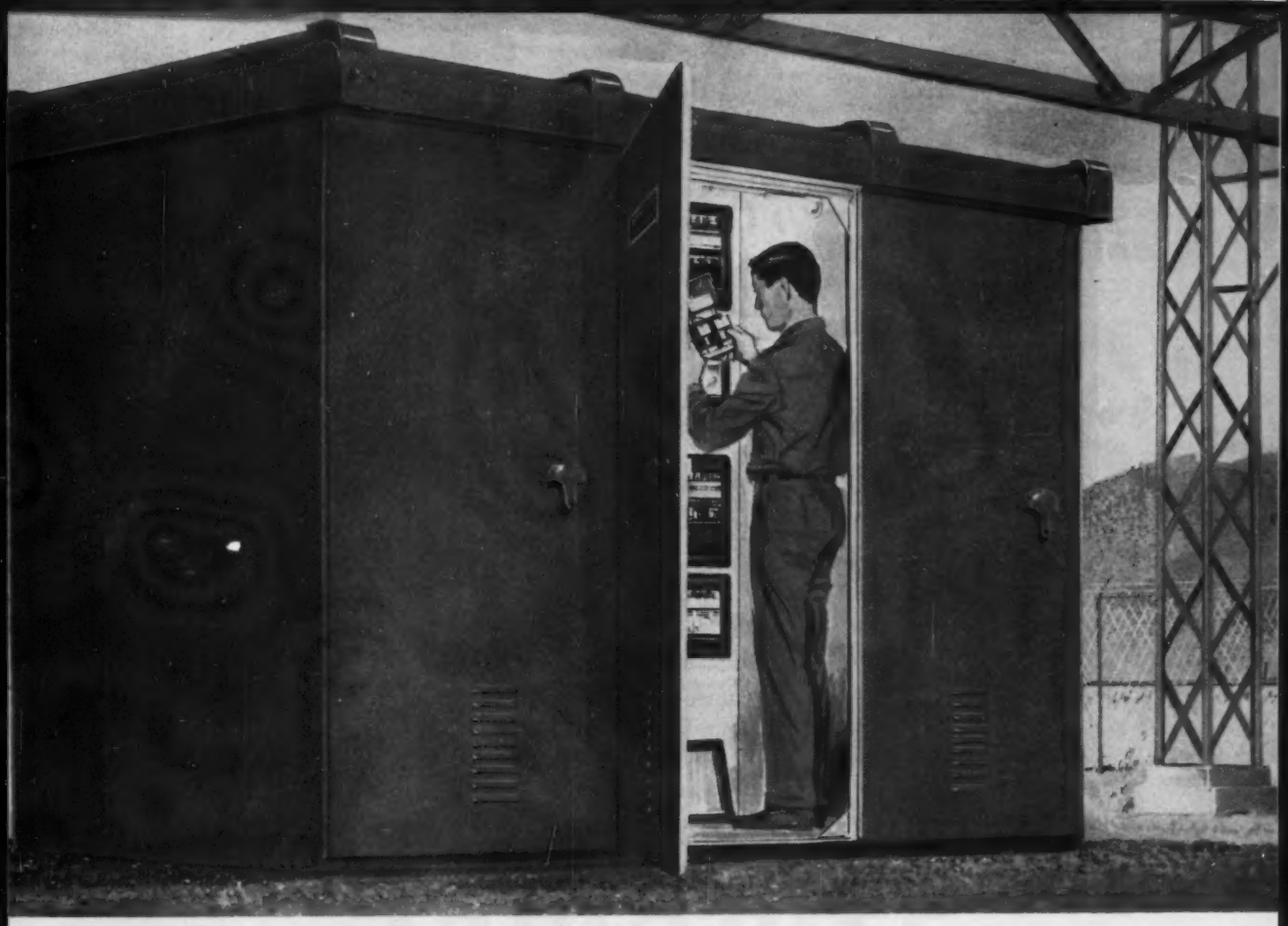
BLAW-KNOX COMPANY

Power Piping and Sprinkler Division

829 Beaver Avenue • Pittsburgh 33, Pennsylvania

Complete facilities for prefabrication and erection of piping systems for all pressures and temperatures ... complete line of standard and custom-engineered pipe hangers, supports and vibration eliminators ... complete line of automatic sprinkler systems for standard and special hazards


WHAT'S
SPECIAL
ABOUT
LJUNGSTROM'S®
easy maintenance features
Ljungstrom maintenance is fast and easy because
it, too, is a "designed-in" function of the preheater.
Necessary work has been foreseen by such money-saving
features as:
• Self-cleaning action that loosens deposits by
expansion and contraction—coupled with high-velocity
soot blowers for daily in-operation purging.
• Cold-end heating elements are factory packed—
can be easily replaced, or reversed when one edge
starts to thin ... which is vital for cold end
service and essentially doubles surface life.
• Large inspection port and vapor-proof light to permit
observation of heating surface, even during operation.
• Trained service engineers make periodic visits and
are available on short notice for special problems.
That's why seven out of ten installations are Ljungstrom.
For the full story write for our 88-page manual.
The Air Preheater Corporation, 60 EAST 42ND STREET, NEW YORK 17, N. Y.



NEW *General Electric walk-in unit lets you . . .*

Work space is heated, lighted.

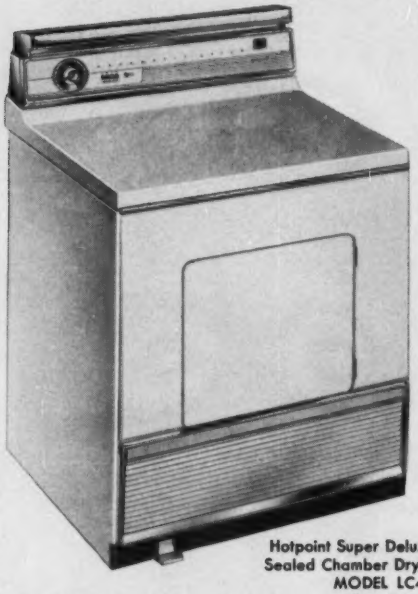
Place your switchboards outdoors to save installation, construction costs

- **You save cable costs by installing your switchboards closer to the protected equipment.**
- **You save space required for control buildings by installing your switchboards outdoors.**
- **Your outdoor unit comes completely assembled for quick, easy installation.**
- **Your operational schedules are not disrupted. Walk-in units can be serviced in inclement weather.**
- **For more information, call your nearest G-E Apparatus Sales Office, or write Section 511-23, General Electric Company, Schenectady 5, New York.**

Progress Is Our Most Important Product

GENERAL ELECTRIC

Hotpoint Super Deluxe
Air-Blower Dryer
MODEL LB45



Hotpoint Super Deluxe
Sealed Chamber Dryer
MODEL LC45

Your solution to increased revenue...

Hotpoint

Automatic Electric Dryers for '58!

Hotpoint offers a complete selection of Automatic Electric Dryers to help you put more of these revenue-producing appliances on your lines. The 1958 Hotpoint Line includes two types, six models. There's one for every need, every budget —each with distinctive new Hotpoint CLEAN-LINE Styling, and loaded with the super sales-appeal that only Hotpoint advanced features can create!

Your Hotpoint Distributor has complete details on Hotpoint's aggressive merchandising support, feature versatility and presold popularity. Ask him to show you how easy it is to build profitable load—and to develop *sustained* revenue—with Hotpoint Automatic Electric Dryers! They will help you put more POWER in "Housepower"—more LIVING in "Live Better . . . Electrically!"

4 **Hotpoint Air-Blower Dryers** . . . with plug-in flexibility! One connection for either 115V or 230V operation. Air-Blower models have giant Wide-Screen Lint Filter for increased drying efficiency.

2 **Hotpoint Sealed Chamber Dryers** . . . no venting required! Ideal for installation in either utility room or kitchen. Cold water spray condenses moisture and the lint and water are pumped down the drain.

LOOK FOR THAT Hotpoint DIFFERENCE
(your customers do!)

Automatic Washers • Clothes Dryers • Combination Washer-Dryers • Electric Ranges • Refrigerators • Food Freezers • Air Conditioners
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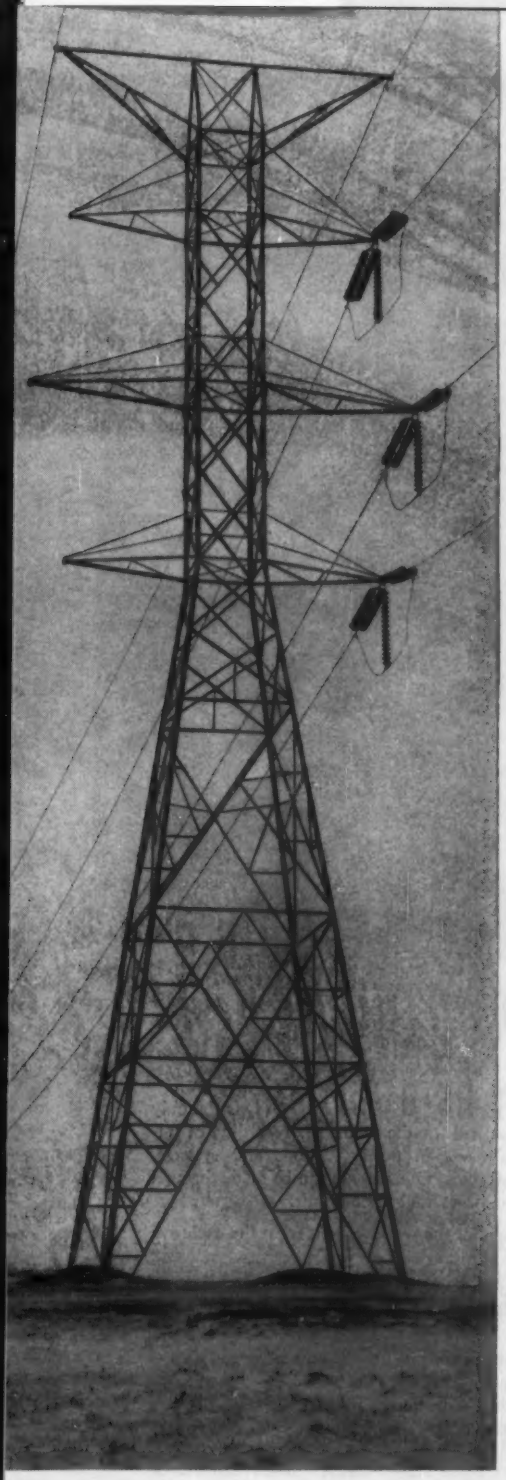

New York State Electric & Gas Corporation erects *54 More* *American Bridge Towers* on new 230 kv line

THIS tall tower is one of 54 recently designed and fabricated for New York State Electric & Gas Corporation, Binghamton, N. Y., an American Bridge customer for 17 years.

These towers which average 118′ in height comprise a 9-mile stretch of that company's Gardenville-Perry 230 kv line. The tallest tower is 128′; the longest span is 1,270′.

Of the 600 tons of steel used in the 54 towers, about 180 tons, or 3⅓ tons per tower, for all main legs and some of the main bracings, was fabricated of USS MAN-TEN. The use of this high strength steel saved over ½ ton per tower or about 30 tons in all . . . with appreciable savings in freight and erection costs.

The Finest Towers at the Lowest Possible Price!

Since 1911, American Bridge has maintained a modern plant which specializes in the fabrication of electric transmission towers, substations and similar structures. Our towers are designed for the specific conditions of loading expected on your line. Generally, all tower members are made alike on all four sides to facilitate erection. Even the bolts which we furnish are of the same diameter, and they are sorted, packed and marked so that no time is lost in looking for the right fastenings. Every member is stamped in the steel to coincide with easily read erection drawings. And, because our towers are galvanized *after* fabrication by the hot-dip process, their protective coating lasts for years.

For more information about our ability to save you money on your tower requirements, just contact the nearest office.

AMERICAN BRIDGE DIVISION, UNITED STATES STEEL CORPORATION • GENERAL OFFICES: 525 WILLIAM PENN PLACE, PITTSBURGH, PA.
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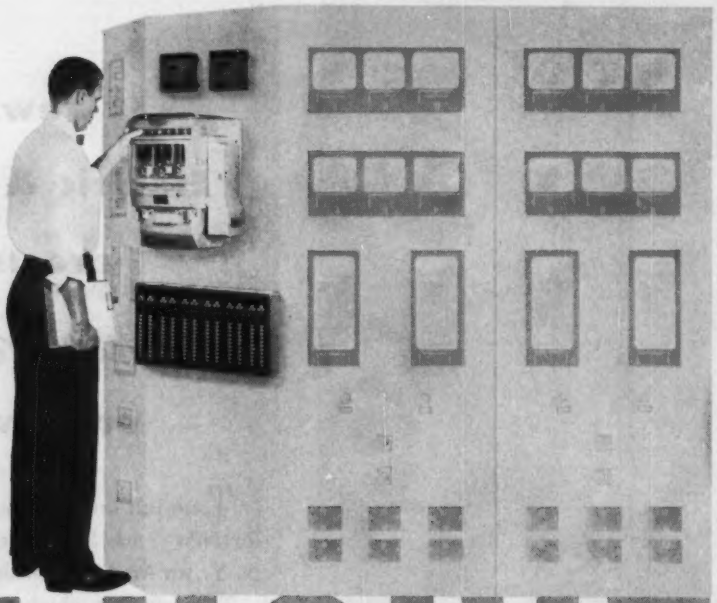
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

AMERICAN BRIDGE

Transmission Towers



EXCLUSIVE

CONSTANT DEPENDABILITY

for the power utility field

The HATHAWAY RS-9 *Fourteen* is the only oscillograph specifically designed for the automatic recording of unanticipated faults and transients in power stations and systems. Economical maintenance and rapid adjustments can be made through the hinged panels leading to all internal mechanisms.

Hundreds of utilities throughout the world benefit from the exclusive features of the RS-9.

- **14 channels on 10″ chart** Voltage, current, power or phase-sequence may be recorded on each channel
- **Two millisecond starting** Complete information is insured
- **Magazine loading** Convenient to remove or attach
- **Automatic record advancement** Eliminates foggy records by constantly supplying fresh paper
- **Time recorder** Year, month, day, hour, minute and second are printed as record starts
- **Precision-made shunts** Choice allows control of current and/or voltage—may be panel-mounted

For specific information on these and many more exclusive features write for bulletin on the RS-9 *Fourteen*

You can rely on dependable instrumentation by Hamilton

HAMILTON WATCH COMPANY
5800 EAST JEWELL AVENUE • DENVER 22, COLORADO
HATHAWAY INSTRUMENT DIVISION

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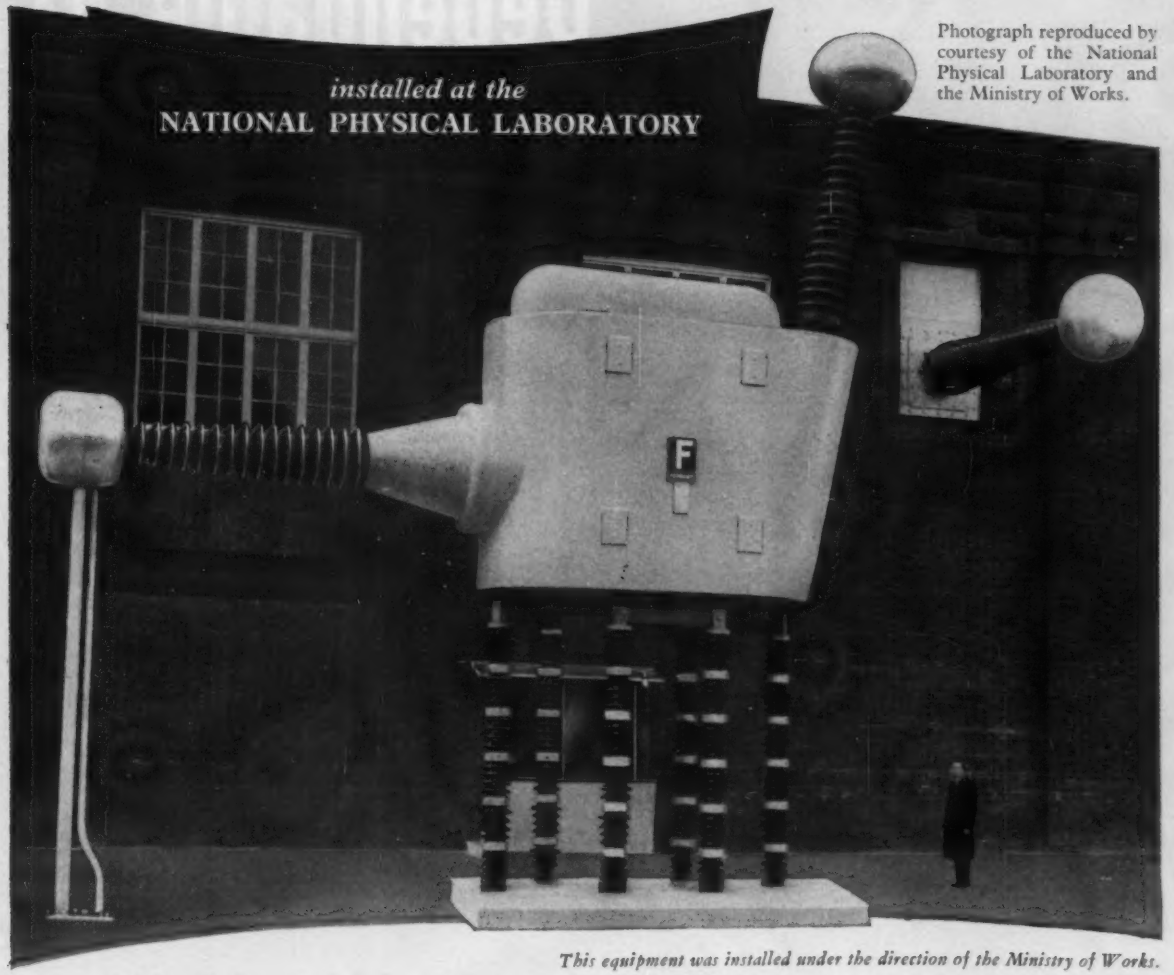
1,000,000 VOLT FERRANTI TESTING TRANSFORMER



Photograph reproduced by courtesy of the National Physical Laboratory and the Ministry of Works.

This equipment was installed under the direction of the Ministry of Works.

THE HIGHEST VOLTAGE OUTDOOR TESTING TRANSFORMER IN THE UNITED KINGDOM

A 1,000,000 Volt Ferranti Testing Transformer operating with the tank at a potential of 500,000 Volts above earth. The transformer is mounted on 6 columns of insulators at a height of 12 feet from ground level. The overall height of the complete equipment is 36 feet. Associated with the equipment is a 1,000,000 Volt wall bushing, 36 feet in length, through which the supply is carried to the test laboratories.

Ferranti are specialists in the manufacture of High Voltage A.C., D.C. and Impulse Testing Equipments for all kinds of research and routine testing and are backed by over 70 years' experience in the manufacture and development of electrical apparatus.

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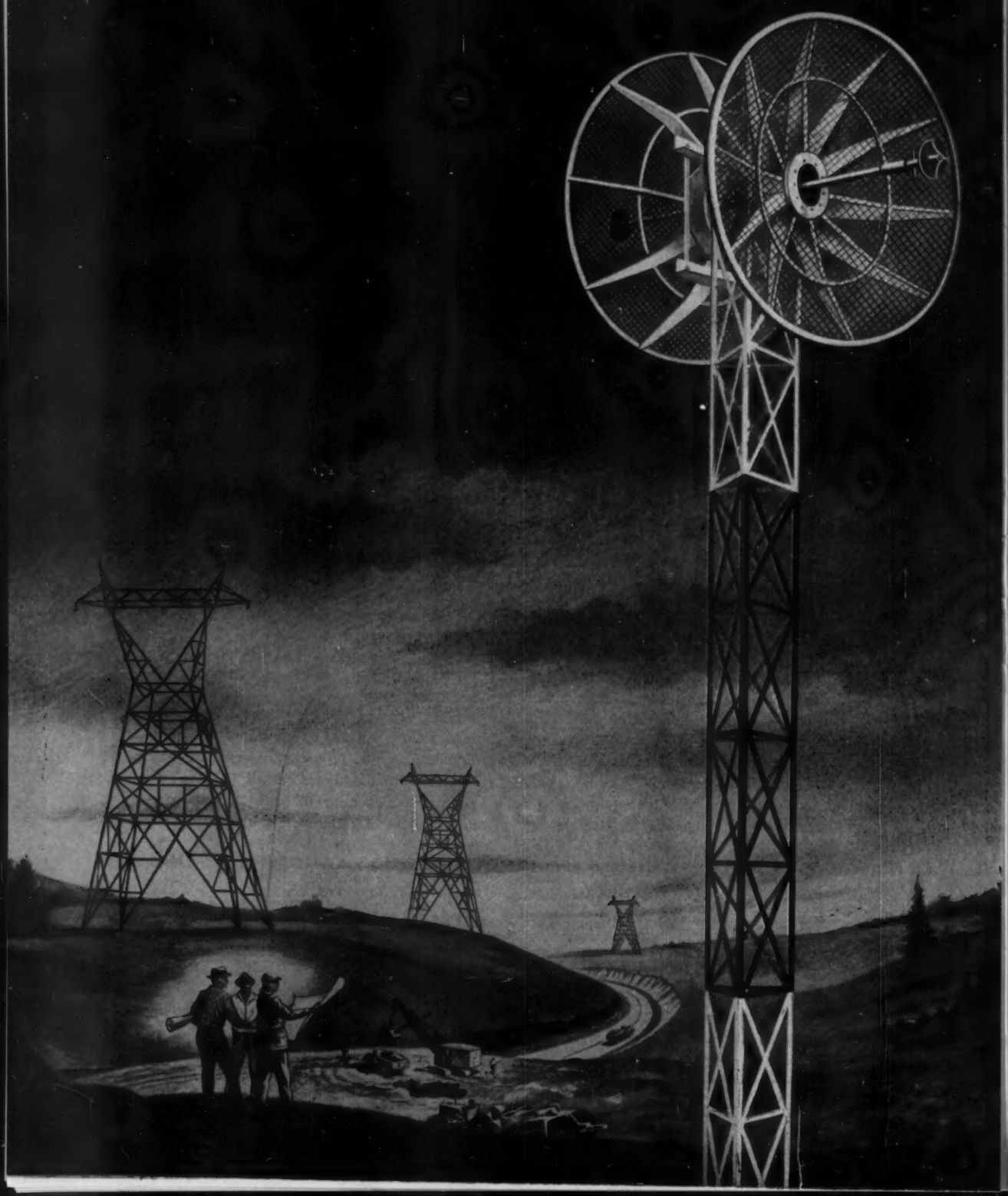
Dependable RCA



Microwave

KEEPS UTILITIES ON THE BEAM

In a tremendous surge of expansion, electric utilities are putting up new installations essential to the national economy, right across the nation.

RCA Microwave is providing these utilities with dependable communications systems, easily expandable, capable of handling every vital communication function including voice, teletype, telemetering, supervisory control, load control, relaying and transfer trip, facsimile, remote control, operation of mobile radio and others.

Through the use of microwave, voice or data intelligence reaches every part of the territory served and the whole system can be under the dispatcher's immediate control.

All this is accomplished with speed, efficiency, reliability and economy compatible with and, in most cases, superior to that provided by any other means—without high maintenance costs, expensive right-of-way problems, or vulnerability to weather vagaries.

ON PIPELINES—In the petroleum and natural gas industries where pipelines knife across the country, RCA Microwave systems link dispatching and control points with pumping stations and unattended remotely operated booster stations. Pipeline capacity is increased and operating costs are cut. VHF control channels allow immediate contact with maintenance personnel.

ON TURNPIKES—On the new cross-country superhighways RCA Microwave provides circuits for voice, facsimile, teletype, VHF control, traffic information and business machine communications . . . gives operating personnel complete control of the road, greater safety and service to driver patrons around the clock, in fair weather or foul.

RCA MICROWAVE provides the most advanced engineering features. Provision for the easy addition of future channels makes it the least expensive form of communication per channel mile. Equipment uses easy-to-service, familiar circuits and readily available tubes. Single sideband suppressed-carrier frequency division multiplex is used exclusively to meet high standards of dependability and quality of transmission. Frequency control for the system is concentrated at the terminal stations. And only *two* frequencies are usually required. Furthermore, RCA provides the nation-wide service of the RCA Service Company to keep your system operating at its peak.

RCA Microwave Representatives, with years of microwave experience, will be glad to answer any questions and to assist in planning your installation. Mail coupon for further particulars.

RCA MICROWAVE is easily interconnected with mobile radio installations as well as existing telephone lines and switchboards. Field maintenance crews, no matter how remotely located, can be contacted from any station or office. Instant communication in the field means hours per day saved in parking, backtracking and preventing costly delays.

PERFORMANCE PROVED IN MORE THAN A MILLION CHANNEL MILES OF OPERATING SYSTEMS THROUGHOUT THE WORLD

RCA MICROWAVE

POINT-TO-POINT COMMUNICATION

RADIO CORPORATION OF AMERICA

Communications Products

Camden, N.J.

Radio Corporation of America
Communications Products, Dept. YB-45
Building 15-1, Camden, N.J.

☐ Please send me latest literature on RCA Microwave.

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____

☐ Have RCA representative get in touch with me.

Another CONDENSER designed and built by MARIND

In ever growing numbers, Marind Condenser installations are earning a well deserved reputation for efficient, dependable performance. Designed and built by thoroughly experienced engineering and manufacturing personnel, Marind power equipment products enjoy a reputation for outstanding quality. We have in process of construction units to suit turbo generators to 156 megawatts, and are capable of processing steam surface condensers to any size.

Industrial Products Division

MARYLAND SHIPBUILDING & DRYDOCK COMPANY

BALTIMORE 3, MARYLAND • *Representatives in Principal Cities*

MARIND

STEAM CONDENSERS AND AIR EJECTORS

for stationary power plants and marine service

PREFORMED ARMOR-GRIP SUSPENSION UNITS provide a
Pretty Soft Life for a Conductor
. . . cradled in durable neoprene
No vibration fatigue here. The Preformed Armor-Grip Suspension Unit (AGSU) eliminates failure by eliminating stress concentration.
The conductor is cushioned in a split neoprene core, held securely by Preformed rods that never lose their tight grip, and supported in an aluminum housing. Conductor is protected and longitudinal stresses are distributed through the entire length of the rods—not at one point.
Like other Preformed line accessories, the AGSU obsoletes bolted hardware. It's easier to apply (no tools needed), costs less, does a better job. You get mechanical strength and electrical protection, and—because of the smooth contour and large diameter of the rod ends—corona emission and radio influence are minimized.
Want to know more about the Preformed Armor-Grip Suspension Unit —or see the application demonstrated? Write PREFORMED LINE PRODUCTS COMPANY, 5349 St. Clair Avenue, Cleveland 3, Ohio. Cable Address: Preformed-Cleveland . . . in 10 years the leading manufacturer of armor rods, dead ends, Guy-Grip dead-ends and other line accessories.
PLP
You can look up to Preformed
Made in accordance with or for use under one or more of the following U. S. Patents: 2,722,393; 2,275,019; 2,587,521; 2,609,653; 2,691,865; other patents pending.

5 reasons why

SUPERIOR HIGH AND LOW VOLTAGE BUSHINGS

HIGH VOLTAGE:

Bushings internally clamped — multi skirted for extra long creepage distance—terminals will accommodate either copper or aluminum conductor in full range of sizes required by EEI-NEMA Standards.

LOW VOLTAGE:

Bushings of wet process porcelain interlocked with tank to prevent rotation — solderless connector type terminals highly resistant to stress corrosion; will accommodate either copper or aluminum conductor in full range of sizes required by EEI-NEMA standards.

TIME SAVING EXTERNALLY OPERATED TAP CHANGER

Eliminates entering tank . . . tap position can be quickly identified and easily changed without disturbing transformer seals. Entire assembly impulse tested in accordance with NEMA standards. Stationary contacts of forged copper with round heads for easy operation, long life. Insulated handle grounded and marked for positive positioning.

MAINTENANCE FREE TANK

Tank constructed of heavy-gauge, rust-resistant, copper bearing steel. All seams, brackets and mounting pads are arc welded to eliminate moisture collecting cracks and crevices. Tank finish is durable, three coat modified alkyd paint.

Corrosion dangers minimized by domed cover, stainless steel cover band, stainless steel mounting pads.

transformers are better

RUGGED CORE-COIL ASSEMBLY

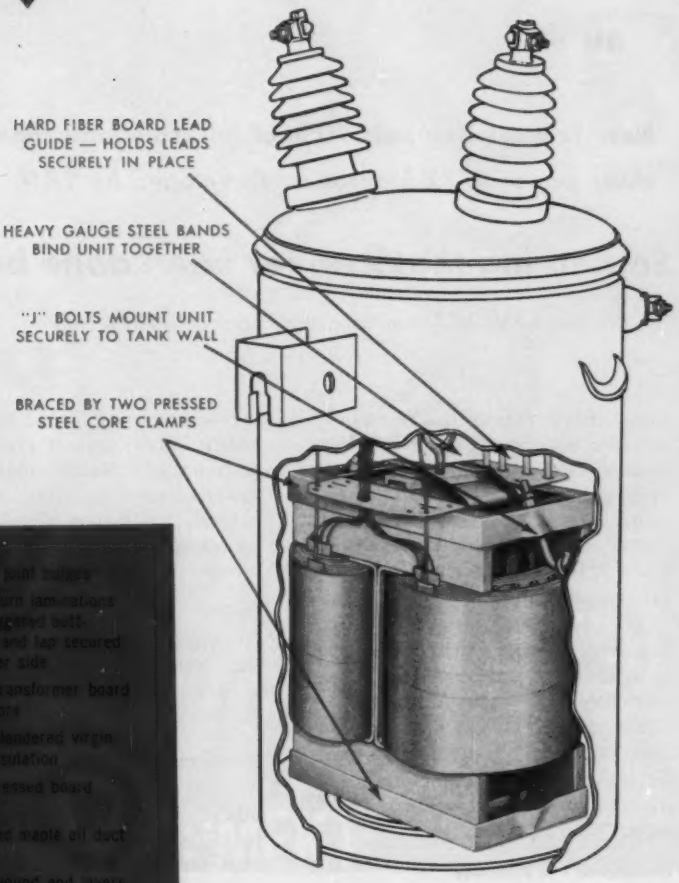
Maximum mechanical strength of core-coil unit is obtained by RT&E's unique core-coil clamping method. This eliminates the conventional vertical clamp members by utilizing the tank for this purpose.

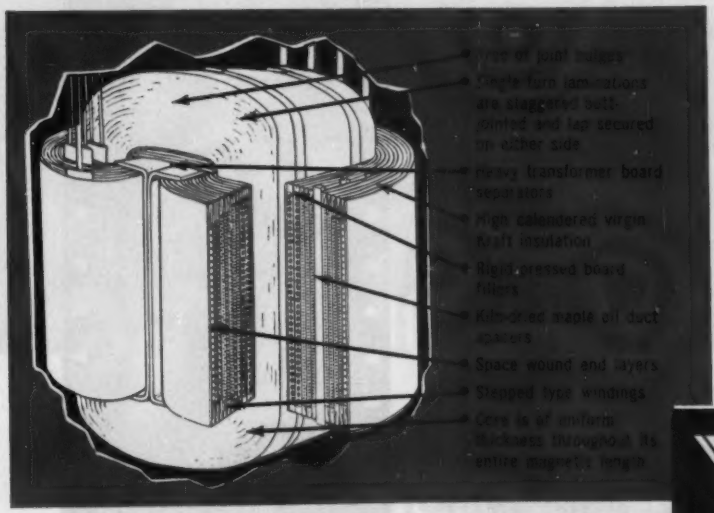
A rigid, unitized construction is thereby attained. Maintains all parts firmly fixed with relation to each other — additional coil surface is exposed to the cooling oil, and additional strength is gained for bracing the coil against distortion during short circuits. Quiet operation assured.

EXCLUSIVE CORE CONSTRUCTION

RT&E's exclusive wound core of single turn laminations with staggered, interleaved butt joints is formed from the finest non-aging, high permeability, cold reduced silicon steel.

This core, together with a coil of outstanding design, results in a transformer that has low losses, regulation and weight and is high in impulse strength and overload capacity.


HARD FIBER BOARD LEAD GUIDE — HOLDS LEADS SECURELY IN PLACE
HEAVY GAUGE STEEL BANDS BIND UNIT TOGETHER
"J" BOLTS MOUNT UNIT SECURELY TO TANK WALL
BRACED BY TWO PRESSED STEEL CORE CLAMPS



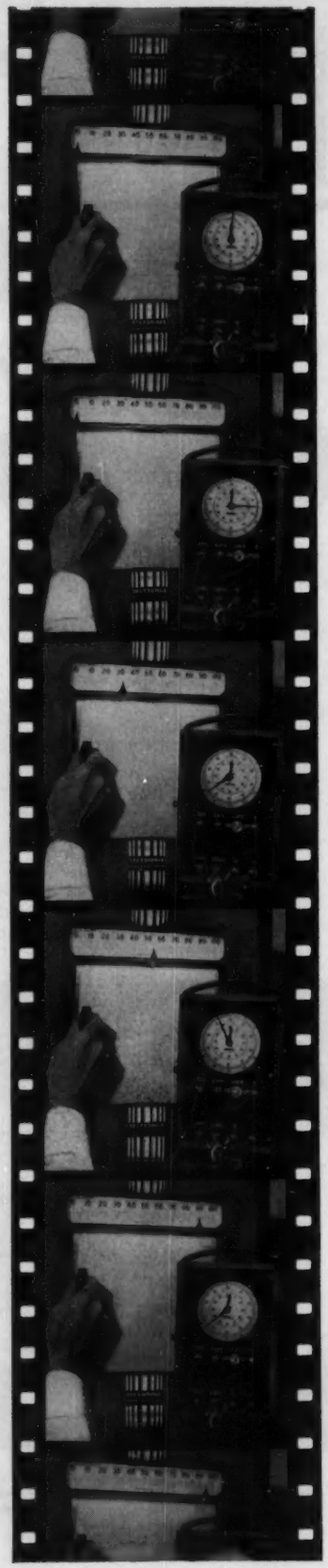
RT&E Transformers are designed and built to the highest standards. A dependable product produced by a dependable company and backed by a full five year guarantee. Available from warehouses conveniently located throughout the U.S.

RT&E CORPORATION

WAUKESHA, WISCONSIN

Helping provide power for America

Another L&N solution to the area regulating problem



These movie films show how fast a simulated full-scale, instantaneous load change is detected, transmitted hundreds of miles, recorded and fed into the load control: at top, a plunger switch triggers the system's primary element, and starts a 1 rps time standard. Subsequent frames show how receiving recorder whips across scale to record 90% of the full-scale change in 1.65 seconds.

New Telemetering puts 90% of full-scale load change on chart paper in 1.65 seconds. Developed by L&N, it's...

Something that's never been done before

Written by W. M. Richardson, Field Engineer, Leeds & Northrup Co.

These movie frames tell the story: the new Speedomax® Variable-Frequency Telemetering System starts feeding remote system data to the control center in less than three *tenths* of a second . . . actually records 9/10 of a full-scale, instantaneous load change in 1.65 seconds.

Already in operation on a number of power company systems, the speed of these new telemeters results in remarkably improved automatic dispatching control. As one operator said, "Automatic control pulses start hitting our generators less than half a second after the inception of a load swing."

Unmatched 1% Accuracy

Greater speed is only the beginning: mean accuracy (*including* end devices) is 1%. This figure does not assume ideal conditions, but is maintained within 107- to 127-volt line variations, ±15 C ambient temperature changes and 59.8 to 60.2 cycle frequency swings. On systems where transmitting-end recorders (optional) are used, sending and receiving chart curves are virtually congruent. This kind of photographic accuracy is especially important on systems contemplating computer-control, for system regulation can be no better than the accuracy of computer input data.

No Drift

Extensive field tests demonstrated that overall telemetering stability holds to within 0.5% per month without the need for recalibration.

Uses Lowest-Cost Telephone Channels

Normal operation is with a new 18-30 cycle oscillator. The new Speedomax Telemeters may also be delivered for use on leased lines where

Continued on page 187

ALCOA RESEARCH

. . Development today for tomorrow's loads

ALCOA'S MODERN EQUIPMENT PRODUCES PLASTIC-COVERED CONDUCTOR AT NEW MASSENA FACILITIES

The operator shown in the photograph on this page is adjusting the high-voltage tester through which all Alcoa plastic-covered conductor must pass before it is approved for shipment.

WITH ALCOA'S SUPERIOR QUALITY CONTROL YOU CAN GET PLASTIC-COVERED CONDUCTORS THAT MEET OR

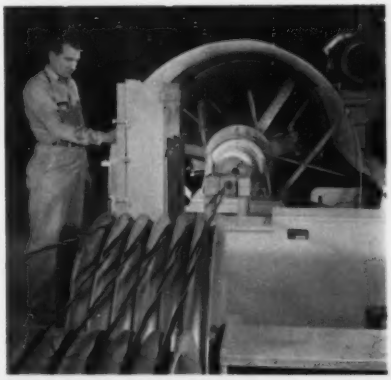
Alcoa has established its own covered conductor department at Massena, N. Y., to enable customers to get the best service combined with the best quality. Alcoa's line of electrical conductors meets the most rigid standards. Using specially developed equipment, modern improvements incorporated in Alcoa's equipment assure the highest possible quality control over the finished covered conductor during production.

In the new manufacturing facility at Massena, quality is carefully controlled throughout the entire fabrication process. By putting the most modern and efficient coating equipment into the hands of the people accustomed to setting the standards of the aluminum conductor industry, a superior product is achieved.

The equipment is designed to apply coating to single wires, 7- and 8-strand and multilayered conductors. Insulated phase wires are

Precision controls on this plastic extruder line permit accurate control of the thickness of the covering. Coating such as standard polyethylene, high molecular polyethylene, high density polyethylene, P.V.C. (polyvinylchloride), etc., may be applied in any of the standard thicknesses or to your exact specifications.

This machine is wrapping triplex cable for self-supporting, low-voltage distribution and service drop use. Triplex consists of two insulated phase wires cabled usually with a bare neutral. Duplex employs one and quadruplex, three conductors, respectively.



Reels of covered aluminum conductor, foreground, are being checked before shipment from Alcoa's warehouse at Massena, N. Y. The "tires" in the background are actually coils of covered conductor packaged on a tire-wrapping machine for complete protection during shipment and storage. Each coil is provided with a ripcord for quick removal of the wrapping.

EXCEED ASA STANDARDS...

wrapped around bare or covered neutrals to form duplex, triplex or quadruplex service drop cables.

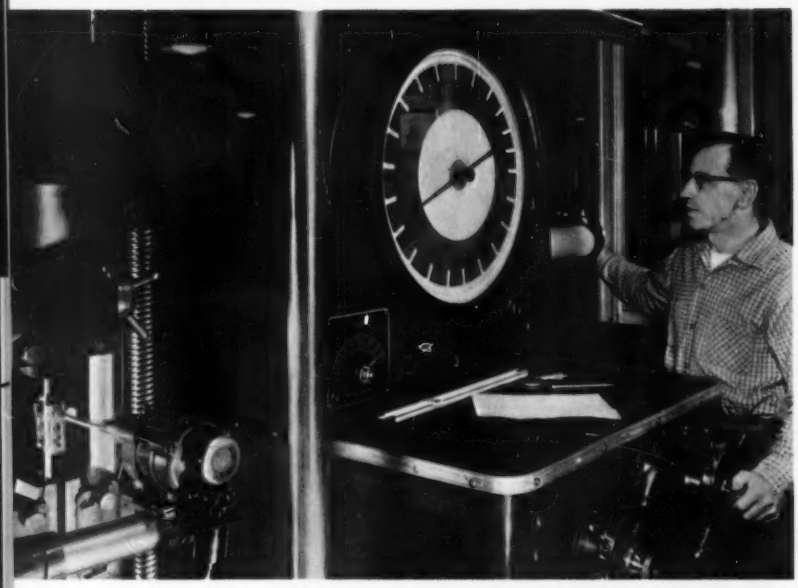
After their final winding into coils or reels, the cables are submerged in water to permit electrical testing for insulation imperfections. Sample strips of covering from the same lot undergo laboratory tests for thickness and composition. Only cables that pass this "acid test" are accepted for shipment.

ALCOA
ALUMINUM
ELECTRICAL CONDUCTORS AND ACCESSORIES
ALUMINUM COMPANY OF AMERICA

ALCOA RESEARCH

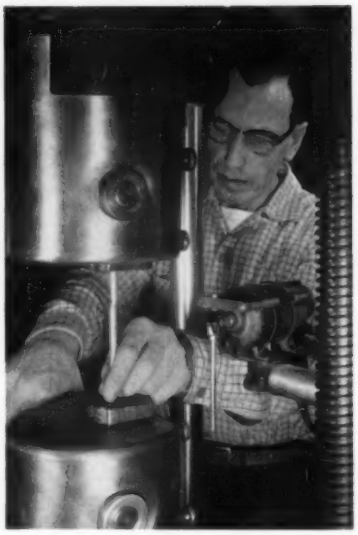
... Development today for tomorrow's loads

HOW THE ELECTRICAL ENGINEERING DIVISION OF ALCOA RESEARCH LABORATORIES SERVES YOU



The success of the Alcoa plastic-covered conductor program was assured by Alcoa's many years of experience as a producer of aluminum conductor. Exacting standards for aluminum conductors have long been a routine at Massena.

Here an aluminum sample rod is being placed under tension in a Baldwin 20,000-pound vertical testing machine. A strain follower has been mounted on the sample and a Selsyn motor is transmitting the sample's elongation to the recording drum near the operator's right hand.



The technician is removing the broken pieces of the rod specimen after it has been pulled apart in the tension test. This view shows the grips and heads of the testing machine. The results of such basic research appear in the uniformly high quality conductor Alcoa produces.

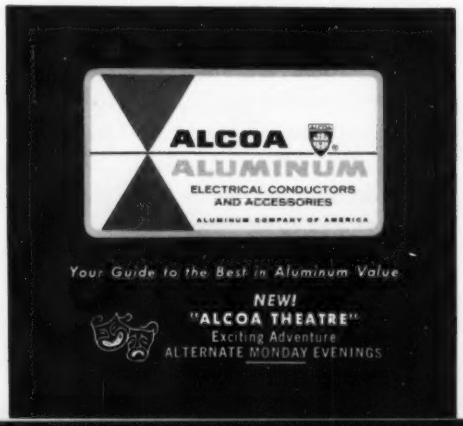
With the use of electrical energy in the United States doubling every ten years or less, there is a crying need for new and better products to serve that demand. Alcoa recognized this need in the early 1930's and set up a special division to concern itself with both the mechanical and electrical characteristics of products supplied to the electric power industry. With headquarters located at Massena, N. Y., it is known as the Electrical Engineering Division of Alcoa's Aluminum Research Laboratories.

In the large indoor laboratory at Massena, research is conducted on all problems involving the use of aluminum as a conductor of electricity. There are several outdoor test spans ranging from 200 to 1,500 feet. Wind conditions at Massena are favorable for the year-round study of aeolian vibration and galloping of conductors. In the winter, temperatures as low as forty below zero have been recorded, facilitating studies of cold weather behavior of conductors.

Extensive research and development are done on aluminum conductors and connectors. Accelerated tests are designed to simulate years of actual service conditions. This is accomplished by repetitive "on" and "off" periods of passage of electric current through the conductor, commonly known as "heat cycling." Inferior connections become excessively hot as the test proceeds. Similar tests are run in high humidity cabinets to obtain accelerated corrosion conditions in salt spray and other atmospheres.

Out of this research and development program has come the best line of aluminum products for the electrical industry available anywhere. With the largest research and development program in the industry and a reputation for leadership, Alcoa offers you more. For assistance with any application of aluminum in the electric industry, see your Alcoa sales engineer or write Aluminum Company of America, 2307-K Alcoa Building, Pittsburgh 19, Pennsylvania.

ALCOA RESEARCH...*Development today—for tomorrow's loads*



When substation design calls for buses to withstand high fault currents, there's often considerable economy in use of insulators of high cantilever strengths. Availability of such insulators affords freedom in structure design, and reduces total number of insulators and points-of-support required.

In the illustration above, the insulators shown are, in order, a Lapp Standard Station Post, a Lapp High Strength Station Post, a Lapp Extra High-Strength Station Post, and a "special" Lapp Station Post of still higher strength. It's "special" only because it doesn't happen to be in the most recent catalog, and because it doesn't fit any previously-established formal strength standards. A customer needed 10,000 lb. cantilever strength in a 23-Kv switch and bus insulator. He got it—in a hurry. If you need an insulator of such characteristics, specify it as Lapp No. 41398. If you need switch-and-bus supports in any other strength rating, we can probably make them, too. The merit of the Lapp Station Post design is reflected in the ease of its stress analysis. The simplicity of the post structure, the uniform reliability of Lapp porcelain, and the certainty of externally-attached caps—instead of pins or inserts—all are such that it is routinely possible to design an insulator into an unexplored strength field, without risk of unknown variables.

At any voltage rating, in any strength class, Lapp Station Posts give you an *extra* margin of operating security, low upkeep, long life.

Lapp Insulator Co., Inc., Le Roy, N. Y.

Lapp

Nine Years of Operating Experience

SUPER-PURE

with the FW Dual Circulation Boiler

Low carryover of silica and solids, at design pressures up to 2200 psi, with low-purity feedwater and make-up as high as 100%, proves soundness of dual circulation design

EXPERIENCE with the FW dual circulation steam generator — now in the tenth year of successful operation — clearly demonstrates its effectiveness in producing high purity steam from waters which had previously been considered unsatisfactory for high-pressure boiler make-up. The following advantages have now been fully realized in installations with design pressures up to 2200 psi, and make-up as high as 100%.

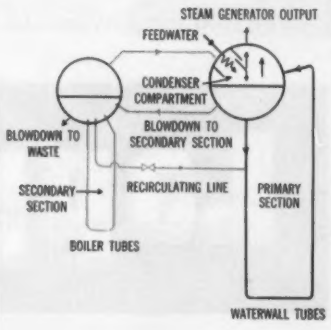
Sharply reduced carryover of silica and solids, preventing costly fouling of turbine blades.

Low concentration in high-duty furnace section, resulting in minimum tube damage and reduced boiler maintenance.

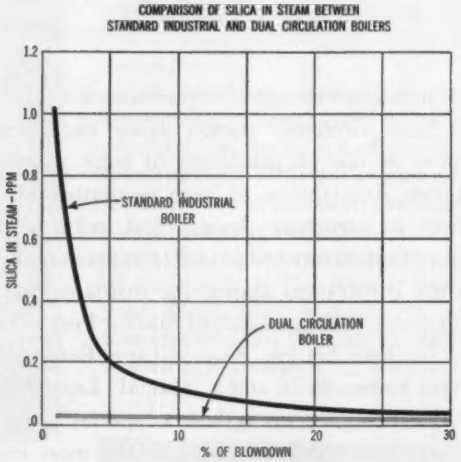
Reduced blowdown with lower heat loss and smaller heat recovery equipment.

Reduced feedwater purity requirements, permitting less expensive water treatment even with high make-up.

The dual circulation boiler utilizes *two* separate heat absorbing sections — a radiant *primary* section (where most of the steam is generated), and a low-heat-absorption *secondary* section (convection portion of boiler). Blowdown from the primary, usually at a high rate, provides feed for the secondary section. This reduces concentration in the primary section to a much lower value than in the secondary section. Steam generated in the secondary section is returned to the primary drum where it is scrubbed by feedwater and condensed in whole or in part before mixing with the primary steam. Even with high concentrations in the secondary, low steam release rates prevent excessive moisture carryover from this section. The effectiveness of this design in reducing carryover of silica to the turbine is well illustrated by the comparative test data plotted below for the conditions indicated. For further details on FW Dual Circulation Steam Generators, send for a copy of Bulletin B-50-11. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*



Simplified flow diagram showing principle of Dual Circulation. Secondary section and blowdown to secondary section are shown in color.



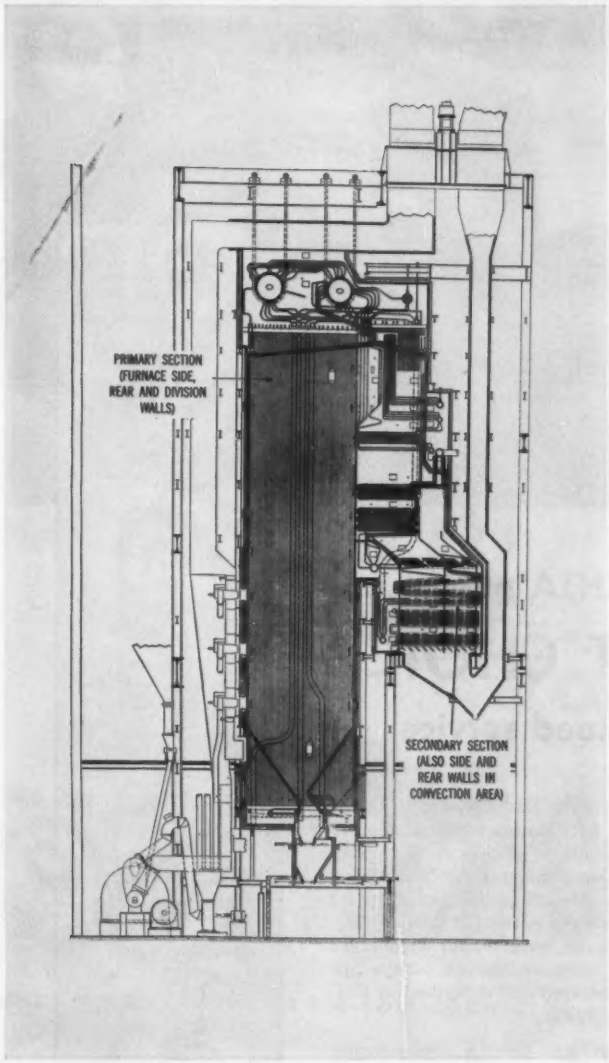
Drum Operating Pressure — Approx. 1500 psi.
Total Soluble Solids in Feedwater — 150 ppm
Silica (SiO_2) in Feedwater — 1 ppm
Evaporation in Secondary Sec. — 33% of total boiler output

FOSTER

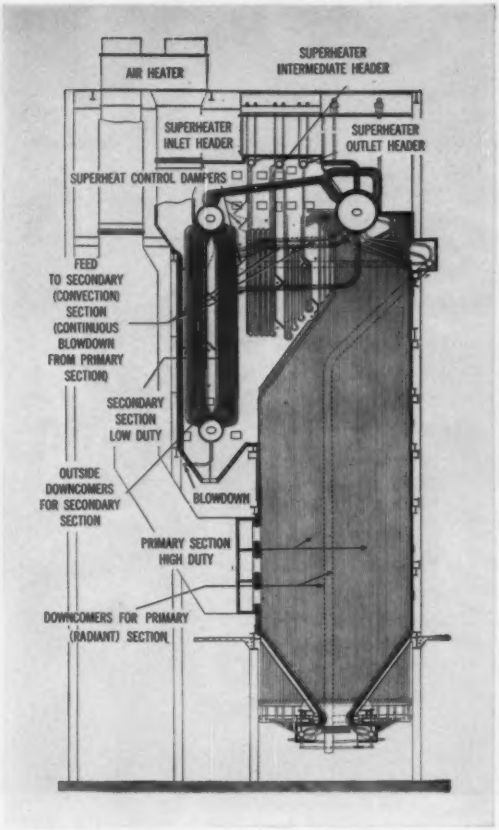
NEW YORK • LONDON

in Generating

STEAM

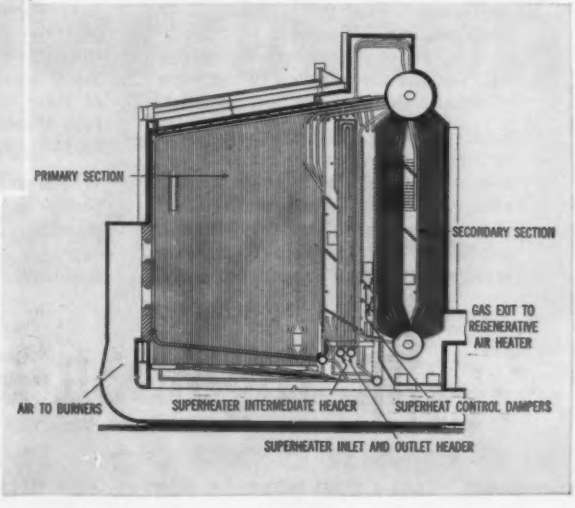


▲ Cross section of Dual Circulation reheat steam generator designed for a maximum continuous output of 1,450,000 lb/hr with a design pressure of 2075 psig, normally operating with low make-up. Steam temperature of 1000F is maintained over a load range from 500,000 lb/hr to maximum rating. The primary section consists of waterwall surface exposed to radiation from the flame and gases while the secondary consists of extended surface heated by convection.



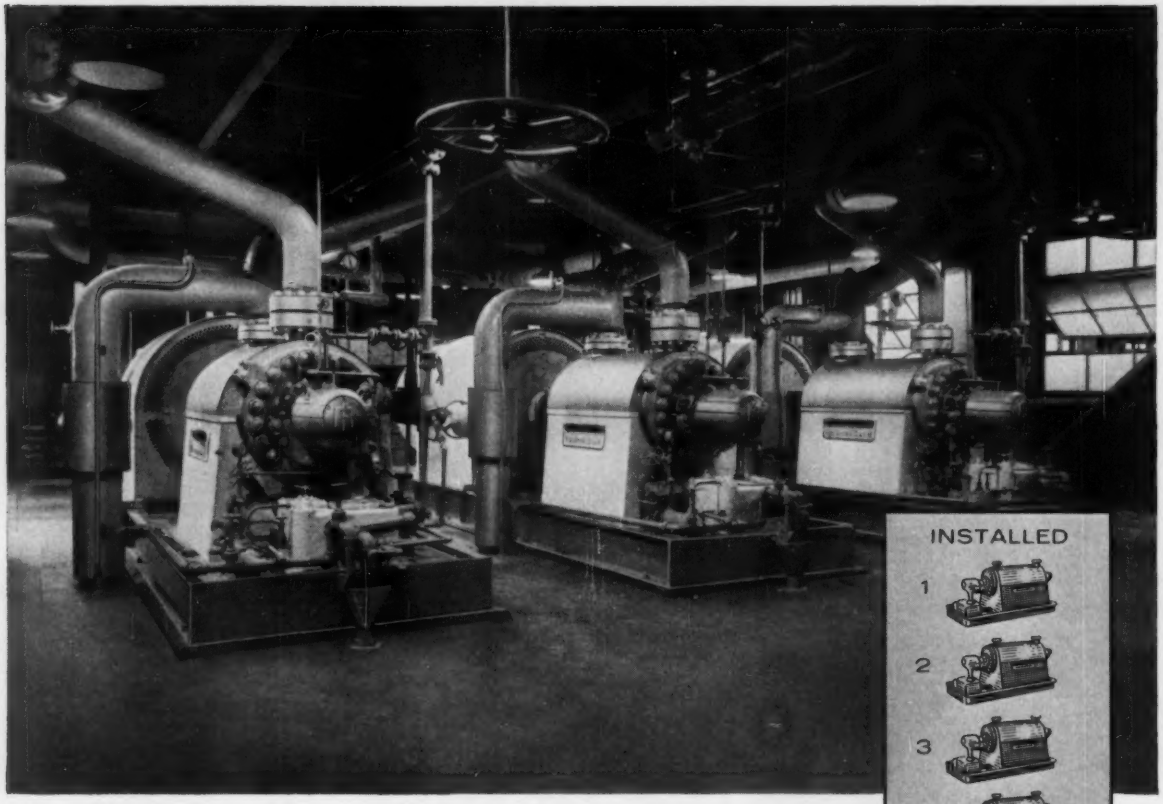
▲ Cross section of a three-drum Dual Circulation Steam Generator designed for 300,000 lb/hr, 1500 psi, 900F, with 100% make-up. Steam-water mixture leaving wall tubes passes through washing and separating compartments in the primary drum. Water from the high-duty section is continuously blown down to the low-heat-absorption secondary section, shown in color. Steam from the secondary is returned to the primary and condensed by incoming feedwater.

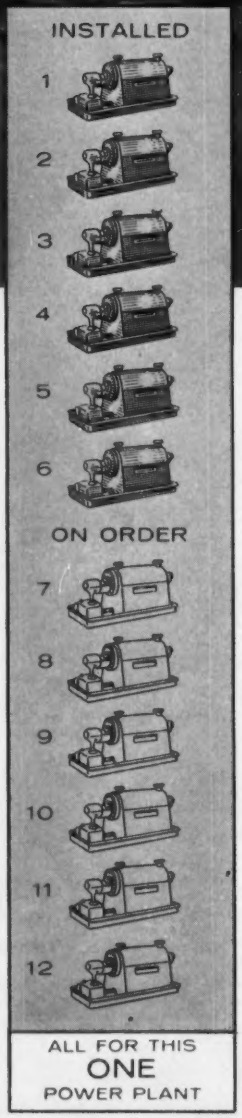
Cross section of a two-drum Dual Circulation Steam Generator designed for 300,000 lb/hr, 700 psi, 750F, with high make-up. Here the primary and secondary sections are segregated within the single upper drum. The waterwall tubes comprise the high-heat-absorption primary section and the boiler bank or convection section comprises the low-heat-absorption secondary section. ▼



WHEELER

PARIS • ST. CATHARINES, ONT.





Twelve more reasons why CHTA pumps are

INDUSTRY'S FIRST CHOICE

for high-pressure boiler-feed service

THE three Ingersoll-Rand 5-stage CHTA boiler-feed pumps shown above are installed in a large southwestern industrial power plant—each unit handling 1150 gpm at 3775 ft discharge head. Three other 6-stage CHTA units are installed in the same plant, and six more are now on order.

Each of these 12 units is another vote of confidence in the *performance* and *dependability* of CHTA pumps. In case after case, repeat orders from satisfied users make them the most widely used pumps for high-pressure boiler-feed service in the 1000 to 6500 psi range.

The Unit-Type Rotor Assembly—a distinctive I-R feature—contributes to high sustained efficiency, maximum strength, easy maintenance and widest possible interchangeability of parts throughout the entire CHTA line. The many unique features and advantages of these advanced-design pumps are fully illustrated and described in Bulletin No. 7211.

Whenever you have a high-pressure boiler-feed problem, your Ingersoll-Rand representative will welcome the opportunity to help you work out the problem to *your* best advantage.

10-639

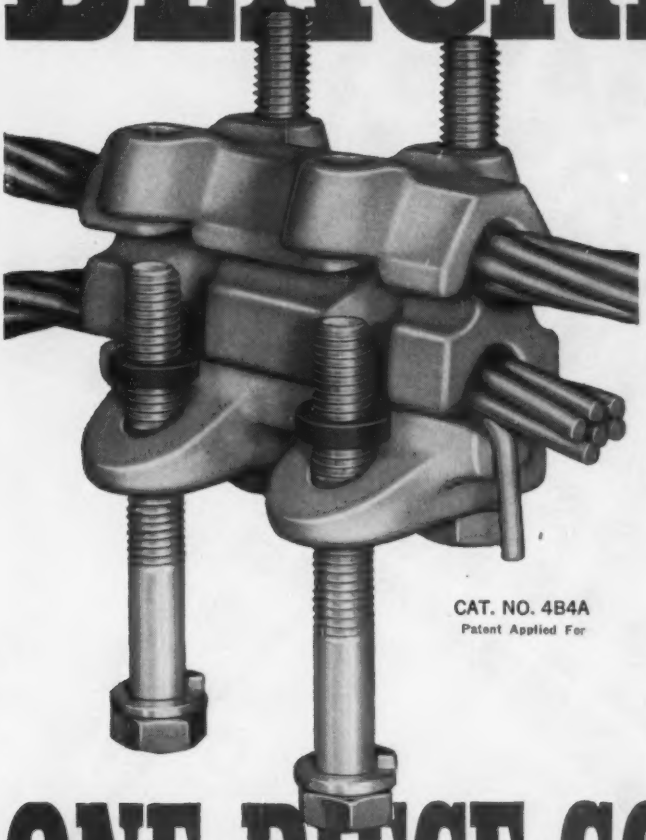
Ingersoll-Rand

11 Broadway, New York 4, N. Y.

COMPRESSORS • GAS & DIESEL ENGINES • PUMPS • AIR & ELECTRIC TOOLS • CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS

It's New! Installs quicker...easier

BLACKBURN



CAT. NO. 4B4A
Patent Applied For

It's here... a heavy duty one-piece 4-bolt connector with all the electrical and mechanical advantages of a U-bolt connector... yet much easier to install.

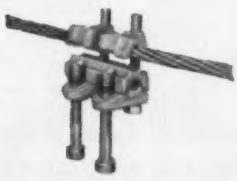
No bothersome nuts, washers, housings, spacer to take apart and assemble. Just three quick, easy steps and installation is completed.

Housings are of non-copper-bearing aluminum alloy. Spacer of soft aluminum pig protects conductor, aids conductivity. Spacer treated with heavy coating of oxide inhibiting compound. Hardware is high strength aluminum alloy completely alumilited to prevent seizing.

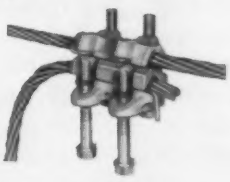
WIDE RANGE...
Accommodates conductors—2/0 to 397.5 ACSR—3/0 to 477 MCM.

ONE-PIECE CONNECTOR

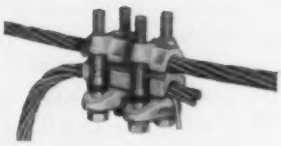
HERE'S HOW EASY THE NEW 4-BOLT CONNECTOR IS TO INSTALL



Unscrew the two free bolts contained with neoprene washers and hang over main.



Insert tap wire.



Tighten and you have the ultimate in a good connection.

Available through electrical wholesalers everywhere

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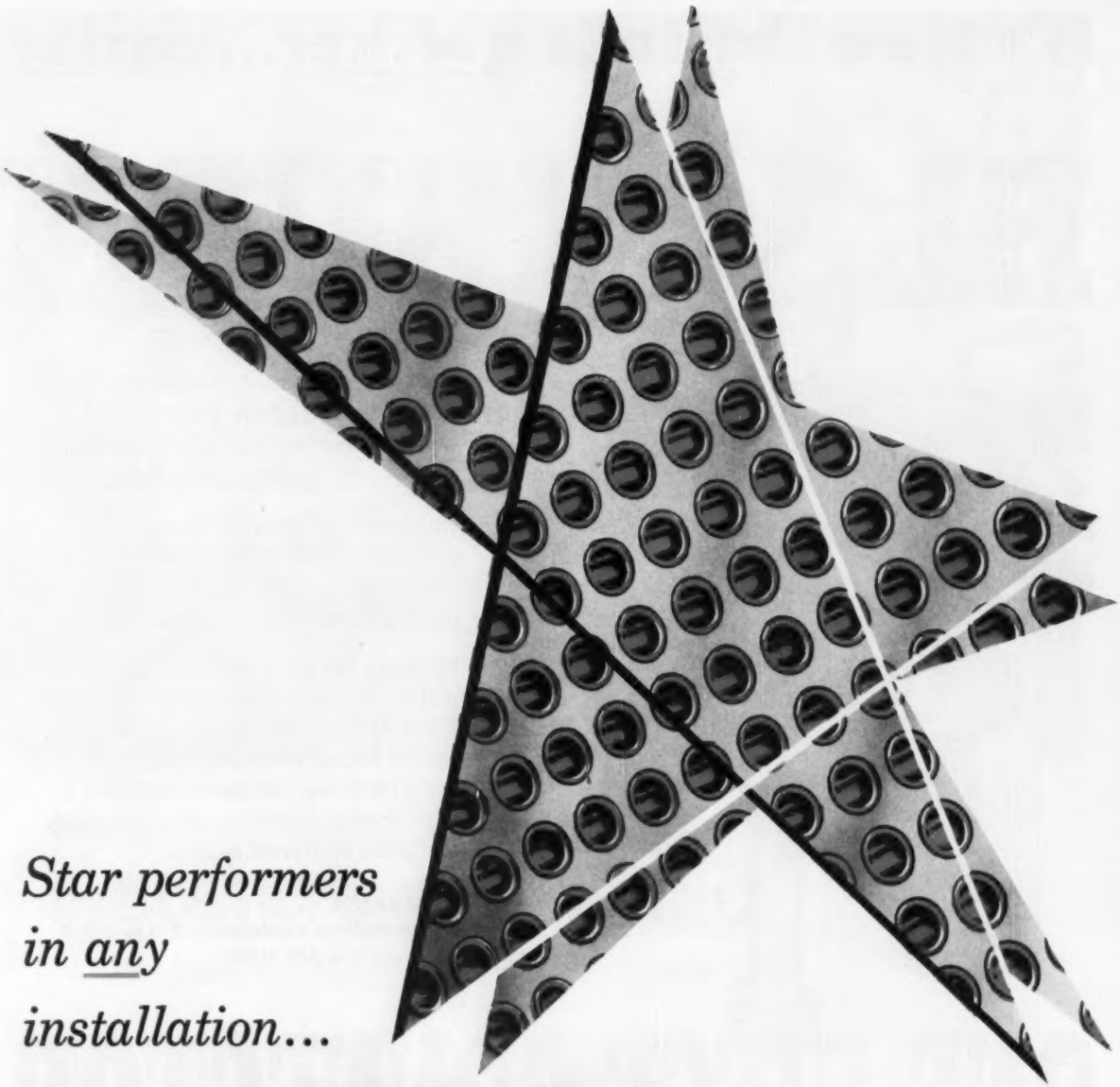

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CHASE® CONDENSER TUBES

Chase Antimonial Admiralty Condenser Tubes lead the way in outstanding performance...length of service. Here's why: Careful alloying, with the proper amount of antimony, all but eliminates dezincification failures. Grain structure is unaffected! The tube stays strong...tough enough to withstand wearing stress and strain. You benefit through longer, more efficient on-the-job service. Learn how Chase can play an important role in your specific installation. Write for your free 54-page manual: *"Chase Condenser and Heat Exchanger Tubes."*

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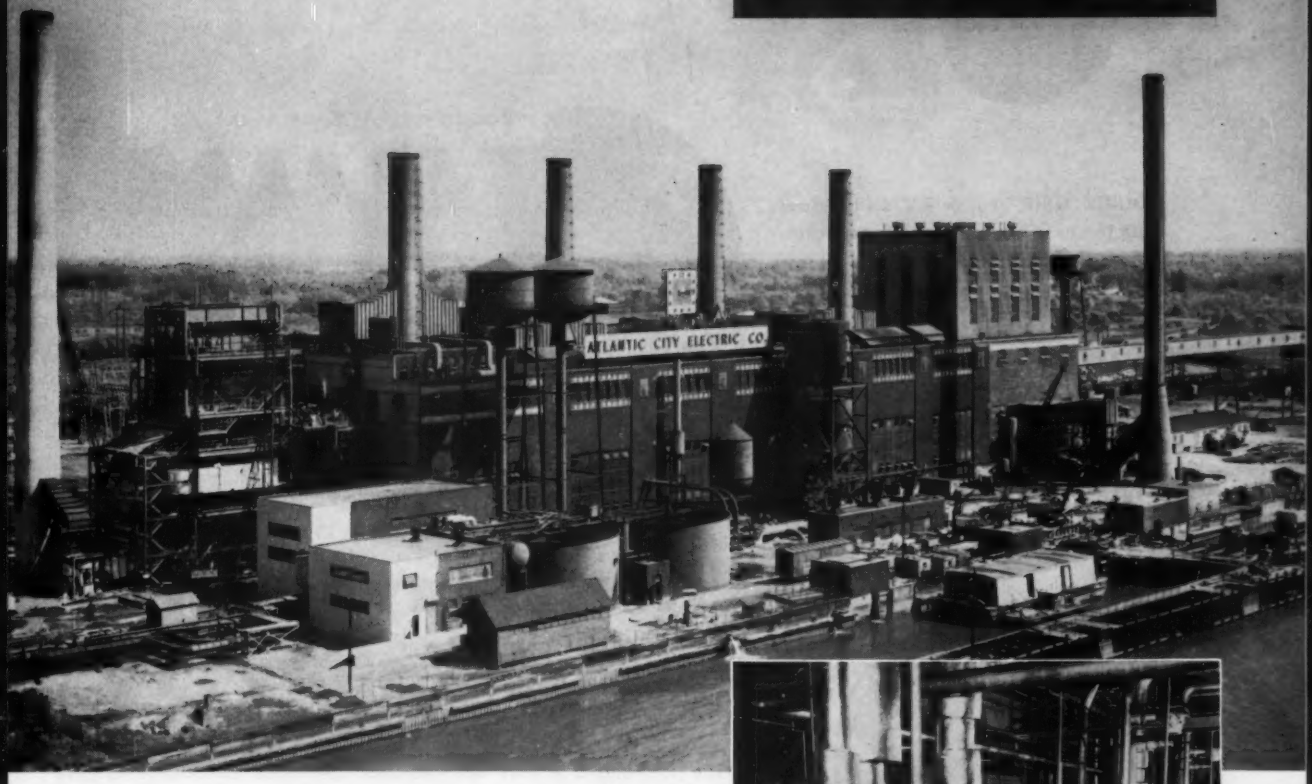
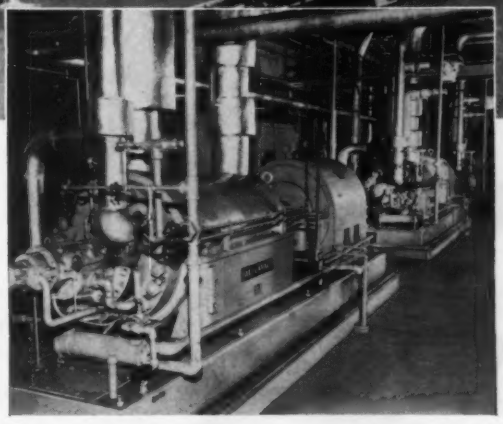
Modern central stations use

DE LAVAL

BARREL TYPE
BOILER FEED PUMPS





Three ten-stage De Laval high pressure, barrel type boiler feed pumps, are on the line at the Deepwater Station of the Atlantic City Electric Company. Shown above is an aerial view of this station located in Penns Grove, New Jersey at the southern end of the Jersey Turnpike. Each pump delivers 675 gpm to the boiler for a total flow of 685,000 pounds per hour. Each pump operates at 1762 psi with temperature at 287 F., and is driven by a 900 hp motor.

When it came time to modernize one of their existing facilities, Atlantic City Electric Company and Gibbs & Hill, Inc., consulting engineers, chose two similar De Laval pumps to serve a new 79,000 kw generator.

IMO Pumps For Fuel Oil Service

Also doing an important job in this Atlantic City Electric Company station are De Laval IMO screw-type positive displacement pumps. They supply fuel oil to the burners round the clock.

Send for De Laval Bulletin 1506, which contains helpful data.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY
861 Nottingham Way, Trenton 2, New Jersey

KUHLMAN "Salesman of the Week"

If you can identify this Kuhlman Electric Co. representative, and are the first one to notify Dept. SA-1, Kuhlman Electric Co., Bay City, Mich., you will receive a valuable gift certificate. Watch for the next Kuhlman "Salesman of the Week."

"QUICK GRIP" for 5 KV and below with the new big grip knob for quicker, tighter line connections.

NEW "QUICK GRIP" for voltages above 5 KV with all live parts protected from birds and animals.

"Here's my favorite success story . . .

"The story begins in 1939 when Kuhlman developed 'Quick-Grip' to solve a particular customer's problem. It proved so successful that it was incorporated into the Kuhlman line. Today, it is universally used as the fastest, safest and most convenient way to make a line connection.

"The story continues when Kuhlman extended the 'Quick-Grip' feature above 5KV to again solve a customer's problem. This 'Quick-Grip' bushing in cover mounted design eliminates the extra expense of bird guards and other protective coverings.

"I like this success story . . . it illustrates how Kuhlman representatives and design engineers work together to solve your transformer problems. What's more—it's a story that never ends . . . for the search for better ways to meet your needs goes on continually at Kuhlman."

578d

KUHLMAN

ELECTRIC COMPANY

GENERAL OFFICES: Birmingham, Michigan

call KE for plant expansion or new facilities

INGENUITY

Our most treasured ingredient at Kaiser Engineers is ingenuity. It manifests itself constantly in new, more efficient, and tested ways of designing and building our clients' plants.

Veteran KE engineers can take your facilities idea from a gleam in your eye through start-up. Or, they can perform any part of the project. One contract can cover all.

KE ingenuity—applied in fresh, daring ways since the start of contracting in 1914—can benefit your facilities. Investigate KE now!

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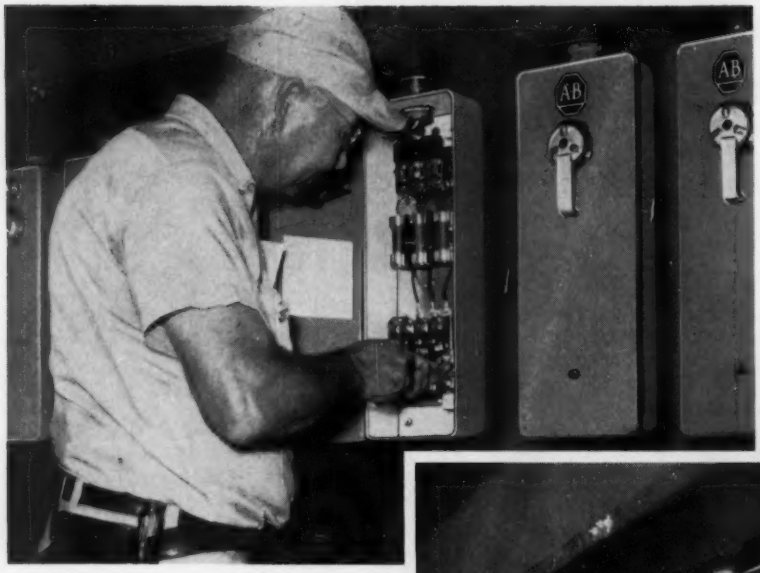
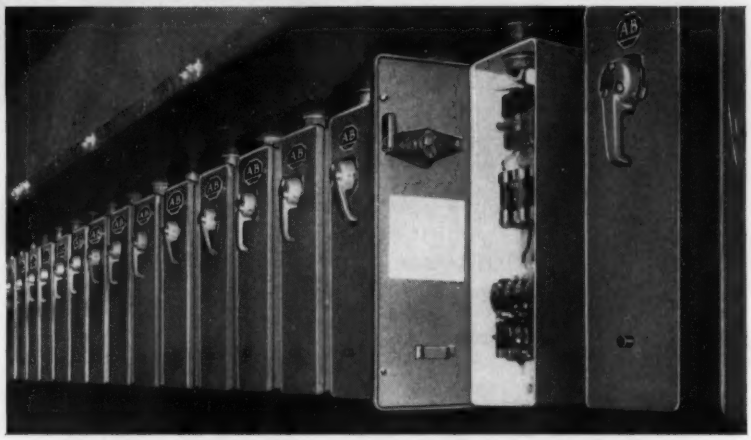
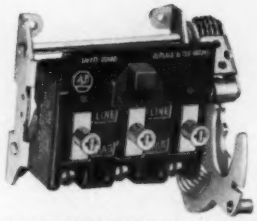


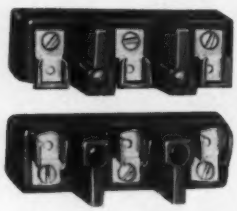


The Sign of QUALITY Motor Control

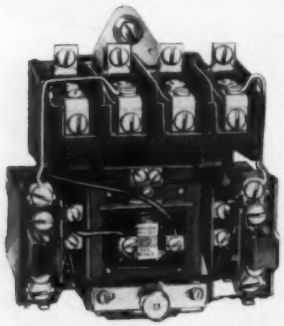
Installation of Allen-Bradley Bulletin 712 combination starters in large Florida packing plant. Electrician is installing heater element on the overload relay.



1. **"OPEN DISCONNECT"** with contacts visible. Any welded contact would be noticed immediately.



2. **FUSES** should be selected in accordance with Art. 430 of the National Electrical Code.



3. **BULLETIN 709 SOLENOID STARTERS** with double break, silver alloy contacts used in all Allen-Bradley combination starters.

COMBINATION STARTERS are the best answer!

When the Electrical Code requires a manual disconnect switch ahead of the magnetic starter, be modern . . . do it the neat, safe way . . . install an A-B Bulletin 712 combination starter.

This popular starter combines in one cabinet: (1) manual disconnect switch with double break, silver alloy contacts; (2) fuse clips (optional); (3) Bulletin 709 magnetic starter.

The disconnect lever and the disconnect switch must be in the "Off" position before the door can be opened. The open disconnect switch contacts are easily visible, while the line connections are protected with an insulating shield. This means complete "safety" for the maintenance man.

The Allen-Bradley Bulletin 713 combination starter can be selected as an alternate. Its disconnect means is an ITE circuit breaker. The "safety" features remain the same.

Send for the Allen-Bradley Handy Catalog containing complete data on these combination starters.

Allen-Bradley Co., 1327 S. First St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

ALLEN-BRADLEY
SOLENOID MOTOR CONTROL
QUALITY

Kellogg's Fabricating Abilities Keep Pace

Culminating many months of intensive work with Philadelphia Electric Company, including the testing and evaluation of numerous alloys, M. W. Kellogg is now fabricating the 2,400 ft. of main steam piping, which it will also install, for Eddystone Station Unit No. 1.

Piping is made of Type 316 Stainless, designed for use at 5,000 psi-1,200 F. at the turbine throttle. Calculated minimum wall equals 2.344 in. from Boiler to Sulzer Stop Valves (8 leads), 2.188 in. from Sulzer Stop Valves to Mixing Header (8 leads), and 2.656 in. from Mixing Header to Turbine (4 leads).

Kellogg's ability to handle the exacting task of bending, welding, heat treating, and testing such huge amounts of heavy-walled pipe to close schedules is a major reason for the company's long-standing reputation in the industry.

The M. W. Kellogg Company welcomes the opportunity to discuss its complete power piping design, fabrication, and installation facilities with consulting engineers, engineers of power generating companies, and manufacturers of boilers, turbines, and allied equipment.

M. W. Kellogg has developed many welding techniques for the fabrication of high alloy steam piping, including K-Weld*. With this unique technique of arc welding, the pipe interior is under controlled inert gas pressure —assuring complete root bead penetration and a highly uniform internal contour without the use of backing rings.

FABRICATED PRODUCTS DIVISION

THE M. W. KELLOGG COMPANY, 711 THIRD AVENUE, NEW YORK 17, N. Y.

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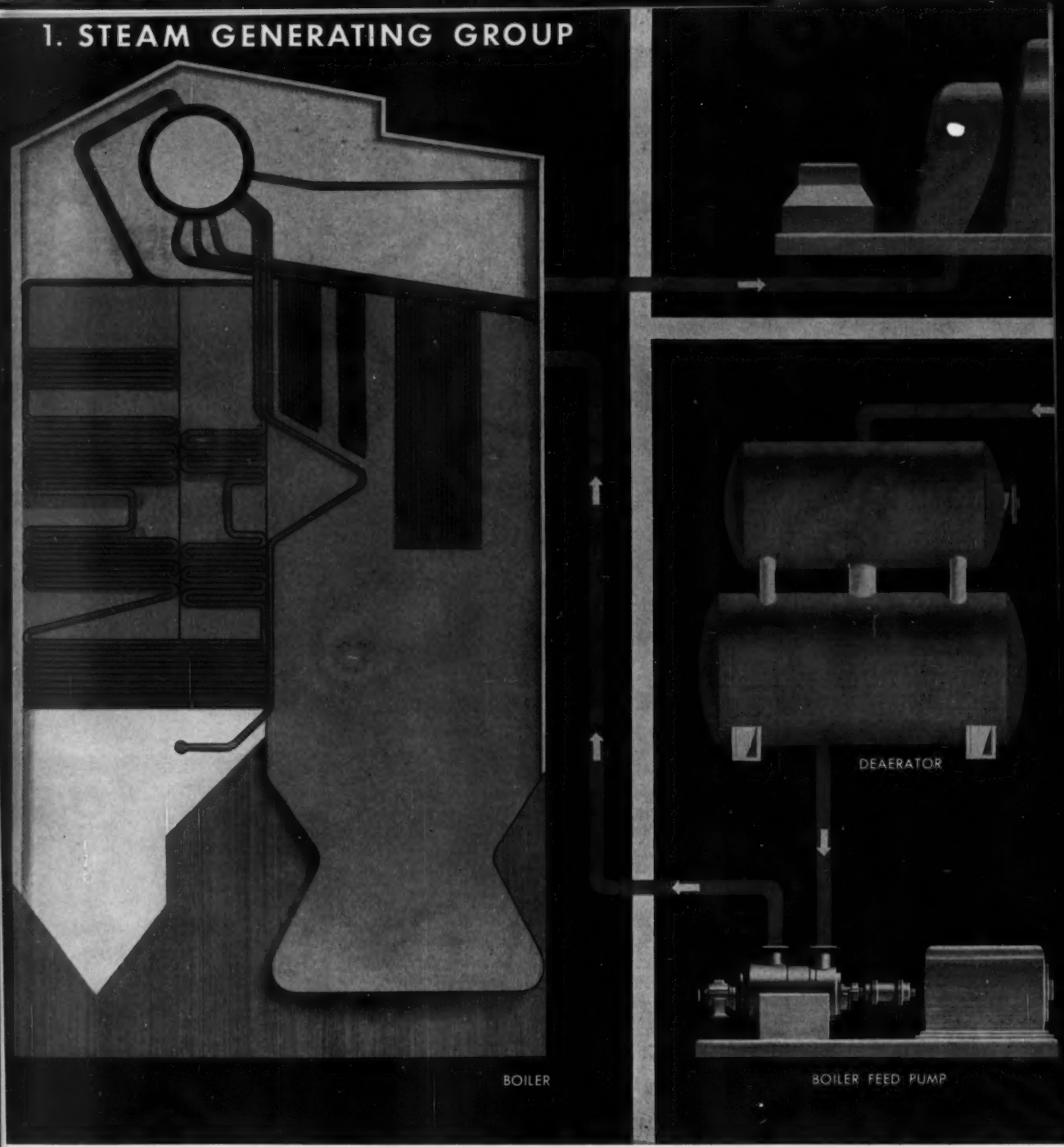
POWER PIPING—THE VITAL LINK

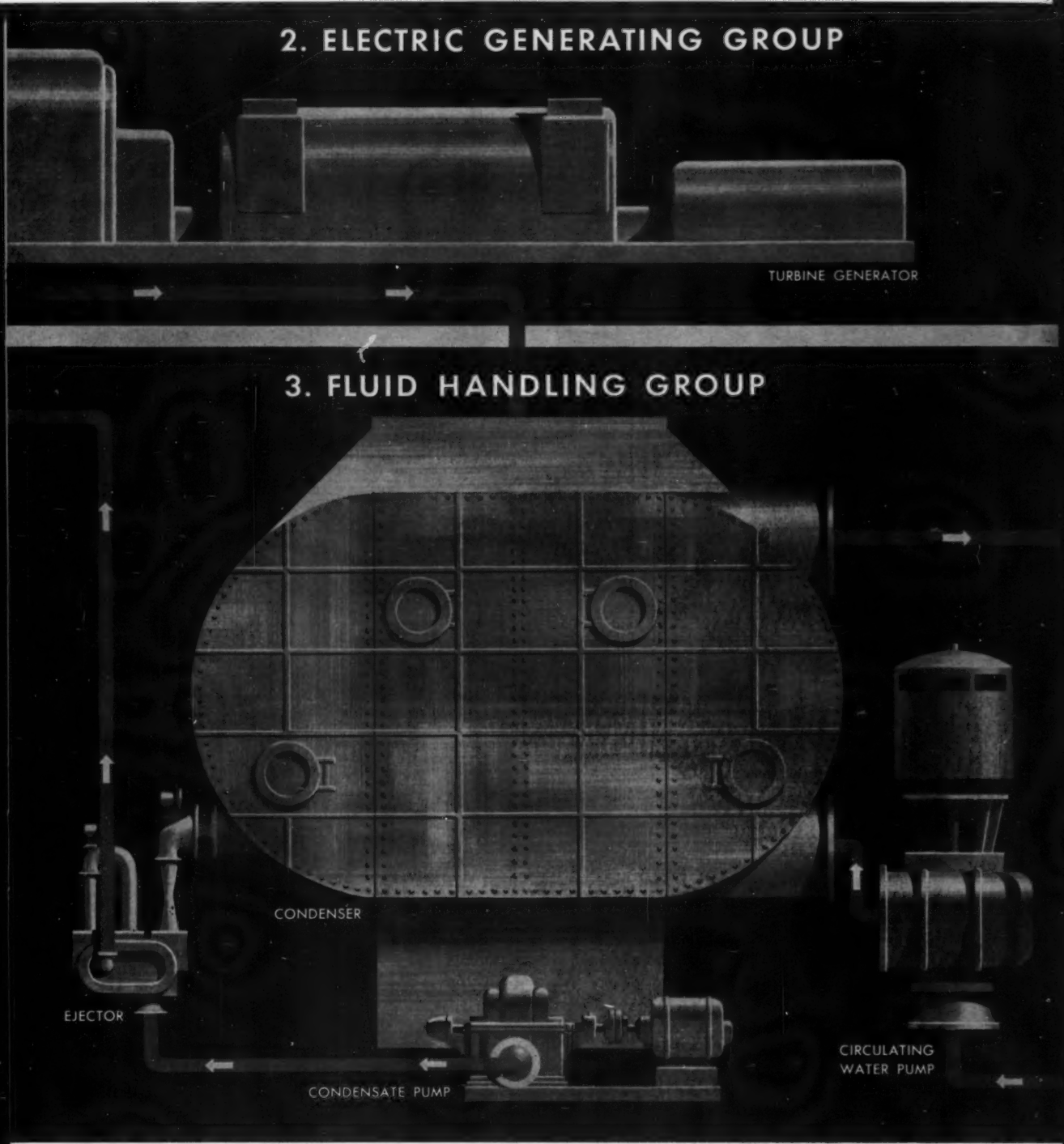
**Trademark of The M. W. Kellogg Company*



Look at all three

A new steam station design approach is bringing higher efficiencies, lower costs, and greater reliability. In this approach, only three basic functions are considered: (1) Steam Generating, (2) Electric Generating. (3) Fluid Handling. Station requirements are first analyzed in terms of the over-all job performed by each of these groups rather than by each individual piece of equipment.

Many of the benefits of this approach occur in the Fluid Handling Group. Here coordination and integration of the wide variety of equipment used can often effect substantial improvement in over-all operation. As steam temperatures and pressures go up, there are increased demands on the fluid handling function. Plant reliability often depends on the effect of one component of the fluid handling group on another during operational transients, either planned or of emergency nature. The solution is coordinated equipment



for power!

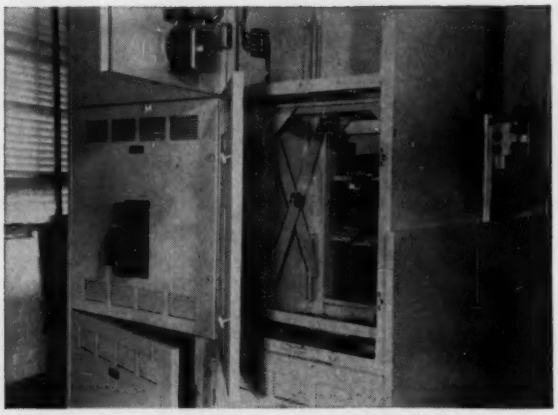
selection, engineering and design. And Worthington's "system" know-how and experience with modern complex plant cycles can help solve your fluid handling problems.

System-wise experience As the manufacturer of all major components of the Fluid Handling Group, Worthington has a reservoir of experience and knowledge that can be of benefit to you. To put this "system-wise" experience to work for you, get in touch with your nearest district office. Or write to section C-71, Worthington Corporation, Harrison, New Jersey.

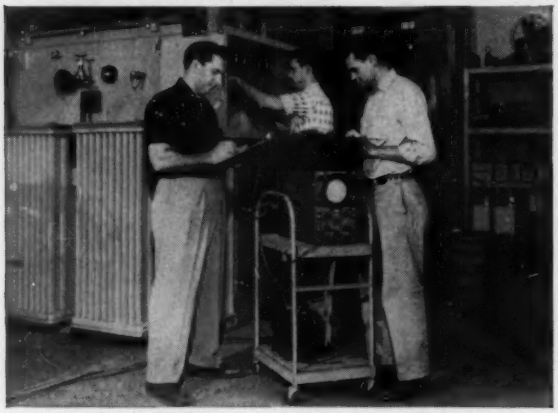
WORTHINGTON

SECONDARY UNIT SUBSTATIONS

ENGINEERED AT I-T-E and coordinated to meet the operating conditions found in your plant.



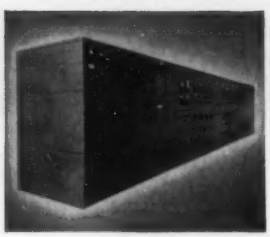
BUILT AT I-T-E with such extra features as circuit breaker test-position with doors closed.



TESTED AT I-T-E to assure ease of installation, and top performance under operating conditions.

SHIPPED FROM I-T-E to assure prompt delivery of one complete "package," ready to install.

I-T-E MAKES IT EASY TO BUY COMPLETELY COORDINATED UNITS



Only I-T-E builds transformers and switchgear in the same plant. This permits them to assume all responsibility for your unit substation requirements. Close association of engineering and production relieves you of detailed planning, paperwork, and the problems of coordinating deliveries. Shipment is from one location. Installation is speeded. Substation components are completely integrated to provide top performance at low overall cost.

Typical of the extra value which *only* I-T-E Unit Substations offer is circuit breaker test-position with doors closed—and without removing them. This means additional safety to operating personnel, greater cleanliness, simplified tagging out of circuits, and longer life. I-T-E Secondary Unit Substations can be supplied for any application, indoor or outdoor, and in any standard rating. For details, contact the I-T-E sales office nearest you. Or write I-T-E Circuit Breaker Company, Switchgear Division, 19th & Hamilton Sts., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY • Switchgear Division

IN CANADA: EASTERN POWER DEVICES, LTD.

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To assure customers of on-time delivery, Southwire operates its own modern fleet of trucks. They travel nearly 3 million miles a year—from coast to coast and border to border.

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Flexible manufacturing schedules, close attention to special orders, and complete warehouse stocks, enable Southwire to provide dependable deliveries to your warehouse or direct to the jobsite.

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- Copper and Aluminum Building Wire
- ACSR and All Aluminum Cable
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- Aluminum Alloy Wire
- Cable Accessories

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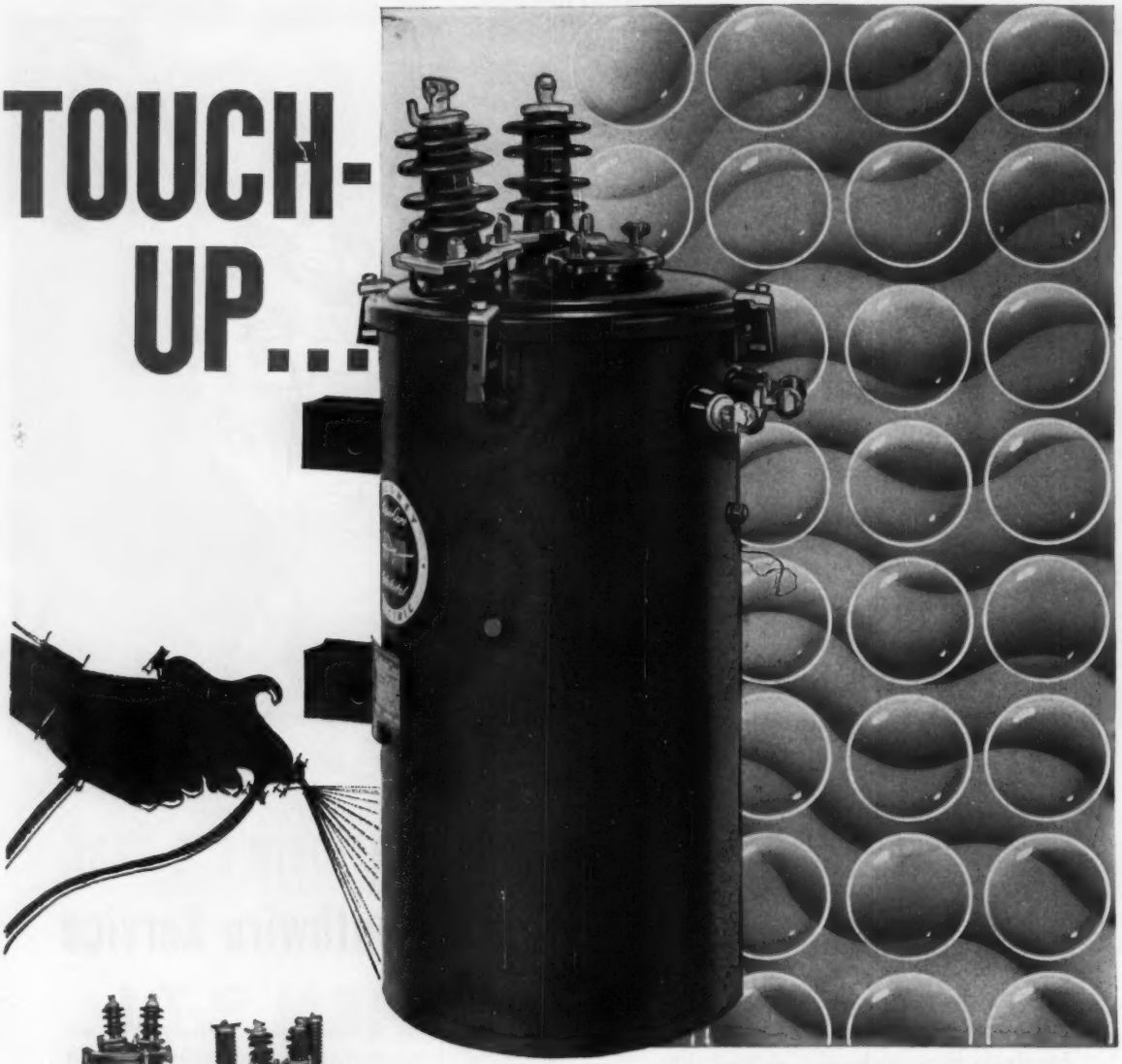
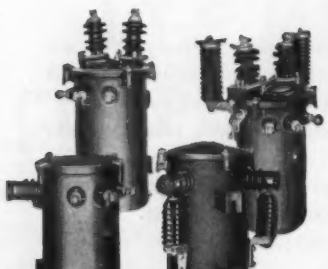
TOUCH-UP...





HyperCore Transformers are available from stock in all Standard Ratings in both Conventional and CSP designs.

MEB6-10

Even Touch-Up Paint Is Sprayed On and Baked

Touch-up paint . . . when required . . . is sprayed on *every* HyperCore Transformer—*just like the original paint.*

It's baked, too, by infra-red heat—just like the original paint.

That's why dependable HyperCore Transformers have consistently uniform and durable surfaces that are highly impervious to weathering. Moloney HyperCore Transformers are *better than ever*—today—because they're products of Moloney's new and mechanized HyperCore Transformer Plant.

MOLONEY ELECTRIC COMPANY

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FACTORIES AT 5390 BIRCHER BLVD., ST. LOUIS 20, MO. AND TORONTO, ONT., CANADA

EDITORIALS

Today's Obligation for Tomorrow's Needs

No one today who will pause to look back over utility system advances of the last ten years and ahead to the problems yet to be faced, can fail to appreciate our need for bold imagination and creative engineering.

Each doubling of industry load demands a redoubling of engineering thought and effort, just to maintain progress. The very parameters of this progress are changing—demanding almost continuous reappraisal and revaluation.

Today we face these system situations:

1. A growing sensitivity of system loads to weather conditions as the public turns to electricity for comfort in winter and summer.

2. Mounting difficulty in scheduling machine maintenance as growing summer peaks repeat themselves with recurring heat storms from June to September.

3. A new need for reliance on interconnection capability to provide reliability in emergencies, interchange for economy, and reserve for maintenance—not only among companies but between power pools.

4. The incremental cost of higher steam pressure and temperature is not being offset by thermal gains.

5. Disappearance of suitable sites for large power stations close to major load centers and the collateral shortage of transmission rights-of-way around large cities.

6. Limited ability of present high-voltage cable systems to handle foreseeable underground power transmission requirements.

7. The apparent inadequacy of existing primary and secondary distribution systems and voltages—particularly secondary systems—to handle future residential loads.

This list is by no means complete. But it will suffice to illustrate the scope and extent of the system problems that challenge the industry's technical ingenuity in the next decade.

Progress is being made in some of these areas. But there is much left to do. In some cases research is clearly necessary, but overall the solutions lie within the framework of our present engineering knowledge.

The basic ingredient is a bold approach, an inquiring mind, and a willingness to break with tradition. To provide it is today's obligation for tomorrow's needs.

Needed—Better Check on Customer Loads

We have a brand new insight into what can happen to residential load in a suburban development when the urge to "live better electrically" really catches on. As a matter of fact so has the power company involved in the episode.

Here's what happened:

About five years ago the company was asked to connect up a block of 45 new homes. In the process its men ran a routine check of connected load. They found a little over 65 kva of electrical appliances consisting of:

5 Central air conditioners	1 Range
45 Refrigerators	5 Clothes dryers

Nothing unusual for a new group of houses. They put in a 75-kva transformer, hooked up the houses, and left.

But this summer they were back. It seems the transformer breaker was tripping out on overload . . . regularly! So they ran a second survey of connected load for the same 45 houses.

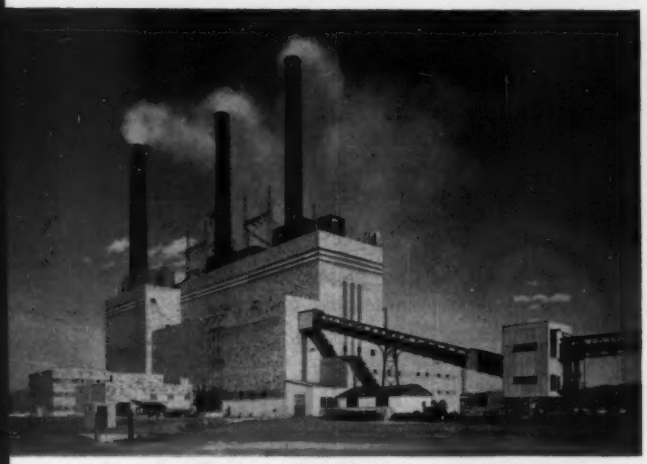
When they compared it with the original service installation report, here's what they found had been added:

6 Central air conditioners	4 Attic fans
39 Window air conditioners	1 Refrigerator
6 Miscellaneous Motors	22 Freezers
6 Ranges	27 Broilers
30 Dishwashers	46 Washers
22 Clothes dryers	2 Ironers

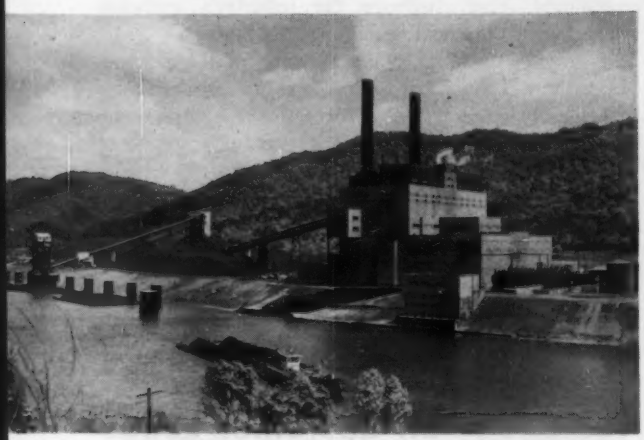
This figured up to 326 kva of new appliance load—none of it there five years ago. It also added up to a much bigger transformer. And that's the point.

This instance may be an extreme example of what's been happening in a greater or less degree on many utility systems. But its severity gives dramatic proof of the need for constant vigilance over distribution feeder and transformer loads, either through periodic measurement or analysis of watt-hour meter records.

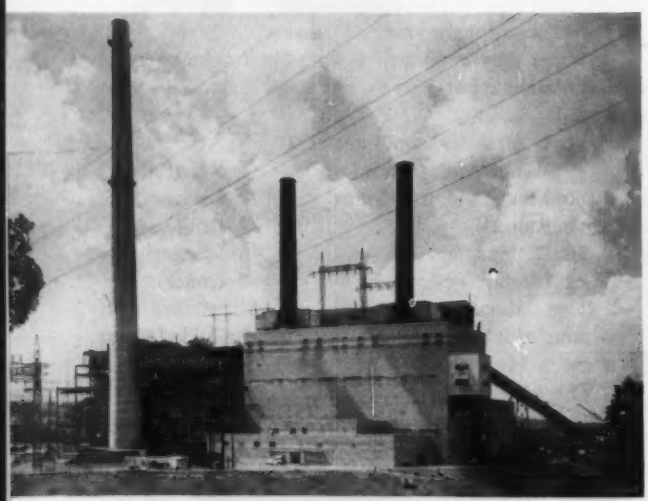
AG&E Tops in Most Efficient Plants



Tanners Creek–9,106 Btu/Kwhr



Kanawha River–9,115 Btu's



Muskingum River–9,176 Btu's

Based on net heat rate, FPC ranking finds stations built or designed by American G&E in clean sweep of first five spots

A build-in-series approach to steam station additions has again helped to put American Gas & Electric Co plants in top U. S. ranking. Success of the approach is underscored by the Federal Power Commission's list of annual average heat rates per kilowatthour for 1956. Stations built or designed by AG&E took the top five positions for efficiency.

Tanners Creek Plant Leads

Tanners Creek Plant of Indiana & Michigan Electric Co led with a 9,106 B/kwhr rate. Appalachian Electric Power Co's Kanawha River Plant was second with 9,115, tied for third were Ohio Power Co's Muskingum River and Ohio Valley Electric Co's Kyger Creek plants with 9,176. Indiana-Kentucky Electric's Co's Clifty Creek and Detroit Edison Co's St. Clair stations tied for fifth with 9,200 B/kwhr. The OVEC and IKEC plants were designed by AG&E.

These figures are published in the ninth annual supplement of FPC's "Steam-Electric Plant Construction Cost and Annual Production Expenses, 1938-1947." The supplement was released late last week.

Three Newcomers to Top Ten

Three newcomers were added to utilities in the top ten bracket. They were Detroit Edison Co's River Rouge Plant (9,210 B/kwhr), Tennessee Valley Authority's John Sevier Plant (9,221), and Toledo Edison Co's Bay Shore Plant (9,282). Pennsylvania Electric Co's Shawville Station retained ninth place with a rate of 9,241.

Three Series Began in 1949

AG&E, a holding company of eight electric utilities in the South Atlantic and East North Central regions, has placed in service or will put on the line a total of 20 generating units in the 150-225-Mw range during 1949-58. The units are divided into three series, with each succeeding series being an enlargement and improvement.

These 20 units, plus the AG&E super-critical Philo Plant machine and two 450-Mw units now under construction, will total 4,942 Mw placed in service in less than 12 years. In addition, OVEC and its IKEC subsidiary put into service a series of 11 units of the 215-Mw size during 1955-56. These were identical to five units in an AG&E series and were designed by American Gas & Electric Co.

In the 1950-56 period, AG&E plants or ones it has designed have ranked as the most efficient in the FPC heat rate tabulations. All are in the 150-215-Mw range, operate under steam pressure of 2,000 psi, and all but Tanners Creek Units 1 and 2 operate under steam temperature of 1,050F first heat and 1,050F reheat. The two exceptions have 1,000F reheat.

ATOMIC PROGRESS

Yankee Reactor Safe, Safeguards Group Says

The Advisory Committee on Reactor Safeguards has told the Atomic Energy Commission it is convinced the proposed Yankee Atomic Electric Co power reactor will be safe to operate.

The statement was made in a report made public prior to AEC's public hearing scheduled for October 8 on the construction permit for the project. Yankee is planning to build a pressurized water reactor to produce 134,000 kw of electrical energy at Rowe, Mass.

This is the first reactor safeguards committee report made public in compliance with amendments to the Atomic Energy Act during the last session of Congress. It was a similar, confidential report that sparked the Power Reactor Development Co controversy and subsequent public hearings.

The committee says, with respect to the Yankee project, that possibilities are remote of any incident which could cause injury. Consequences of such an incident in terms of endangering the health and safety of the public would be low.

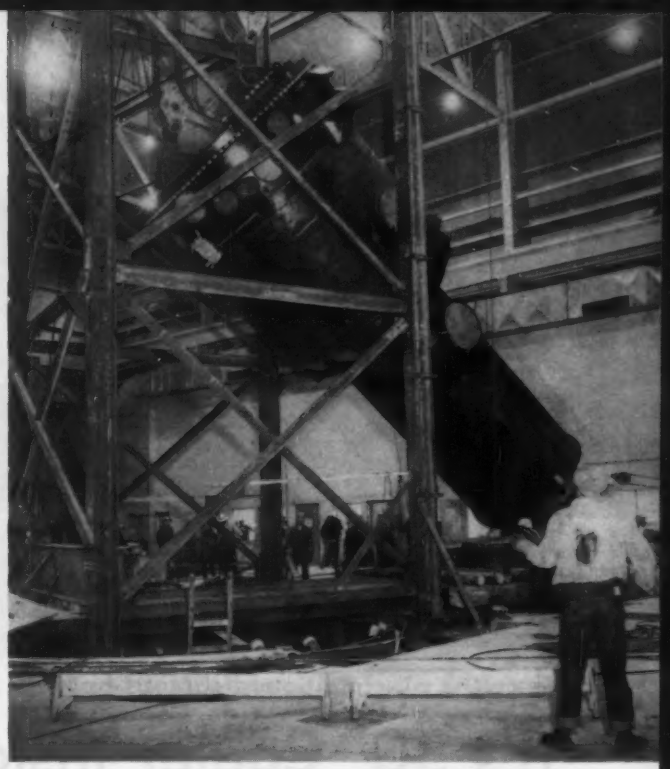
One of the reasons, the committee points out, for its favorable safety findings on this reactor is that it is a type with which there has been considerable experience.

A number of pressurized water reactors have been built for the Navy and the first PWR power plant is nearly ready to go into operation at Shippingport, Pa.

The committee notes three novel features in the Yankee project which bear on safety. These are:

- The addition of neutron absorbers.
- Intentional design into the reactor of nucleate boiling.
- Large plutonium build-up.

Some pertinent design factors may not be confirmed until critical experiments are actually carried out in the power reactor itself, says the committee. Therefore, it will have to review the design again before granting an operator's permit.



Arco Reactor Goes Critical

Soon after workmen had installed the 75-ton vessel (above) of Atomic Energy Commission's Engineering Test Reactor, engineers brought the unit to criticality Sept. 19. It brings into operation the most powerful known source of radiation for use in nuclear reactor development, AEC said.

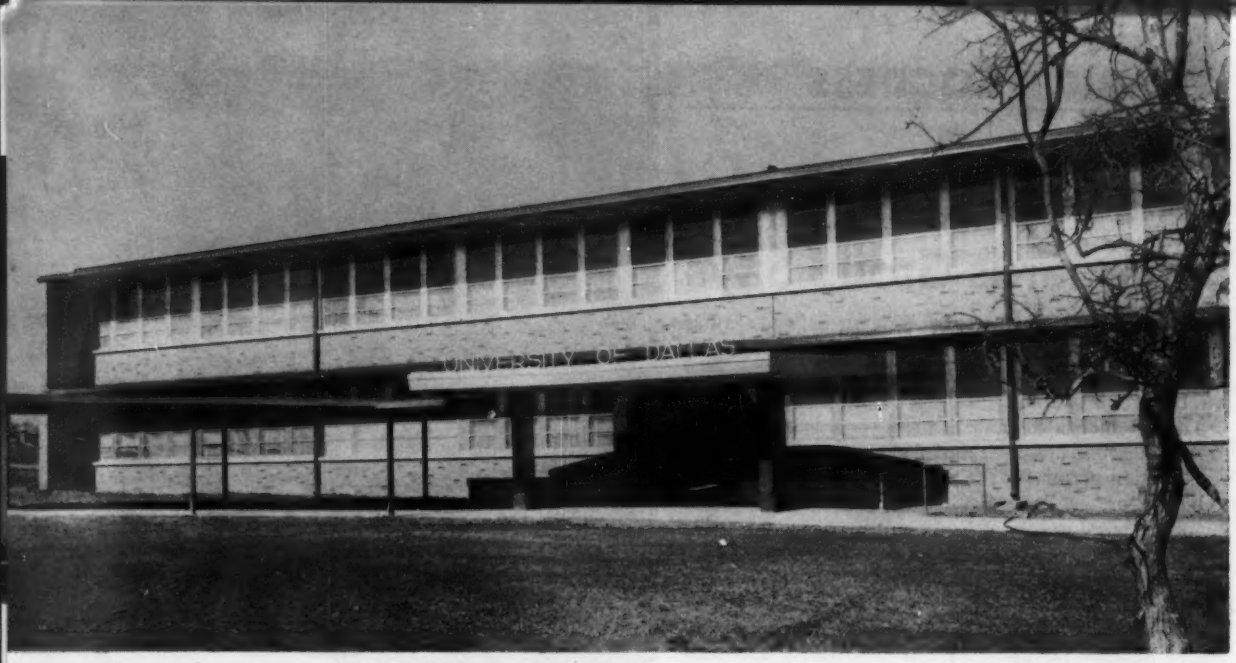
The ETR produces about twice the neutron flux of known reactors for testing of materials. Fissioning process will create heat at a rate of 600-million BTU's per hour, more than four times the heat of any other test reactor. The 35-ft high vessel is cooled by high purity, demineralized water circulating through it at 44,000 gpm. Refueling of highly enriched uranium is necessary every 20 operating days.

GRID PLATE, lowered into vessel at National Reactor Testing Station Idaho, supports core assemblies, reflector pieces

NUCLEAR NOTES

AEC agreement with Consumers Public Power District has been reached on contract terms for a 75-Mw reactor. The Columbus, Neb., utility will pay $5,220,000 of costs for the $29-million sodium-cooled, graphite-moderated reactor. AEC will pay the rest, plus $18 million pre-construction research and development and $8 million post-construction costs.

Nuclear testing center that would be financed with private capital is under study by the ACF Industries, Inc, Kaiser Engineers, Lockheed Aircraft Corp, and Phillips Petroleum Co.



Since the air-conditioned campus opened . . .

It's 30° Cooler Inside at Dallas U

LOUNGE in women's residence hall, like other living facilities at Dallas U, is comfortable even in the hottest weather

CAFETERIA KITCHEN has modern, all-electric equipment. The university's air conditioning keeps the cooks cool too

"America's first all-air-conditioned university" is the title claimed by the University of Dallas at Dallas, Texas.

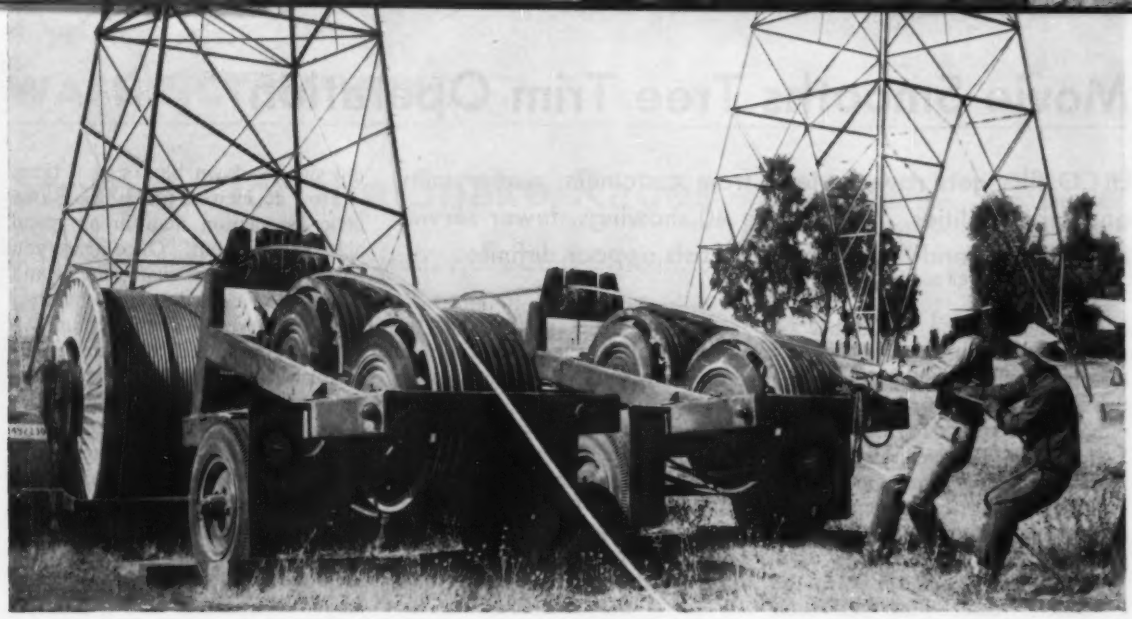
Because Dallas swelters through long stretches of 100F weather, university trustees decided that air conditioning would aid the academic atmosphere. Accordingly, when they started to erect all new buildings last year, air conditioners were included in the initial plans.

The university's president, F. Kenneth Brasted, says the trustees were convinced that the health and comfort of students and faculty alike would benefit greatly from this move. The long periods of hot weather, particularly during the summer session, were a handicap to study in the classrooms and in the residence halls. Watching more and more commercial buildings and homes around Dallas convert to air conditioning for relief, the trustees felt that it was sure to be installed eventually. So, they reasoned, why not now?—and included it in the buildings as they were erected.

Six air-conditioned buildings were completed for the 1956-57 school year. These are the science building, two residence halls, the lecture hall, chapel, and cafeteria. Two additional buildings are under construction.

Worthington compressors of the reciprocating type were used throughout. The science building (shown in the picture above) and adjacent lecture hall are served by a 120-ton unit. The girls' residence hall and cafeteria have a 30-ton unit for the two buildings, and another 30-ton conditioner cools the men's residence hall and the chapel.

In keeping with the "Live Better Electrically" theme, Dallas also installed a completely electrical kitchen in its cafeteria, with a connected load of 120 kw. Dennis S. Coffman, manager of industrial sales for the Texas Power & Light Co, says it is one of the most modern of its kind in the area.



Transmission Work to Set Fast Pace

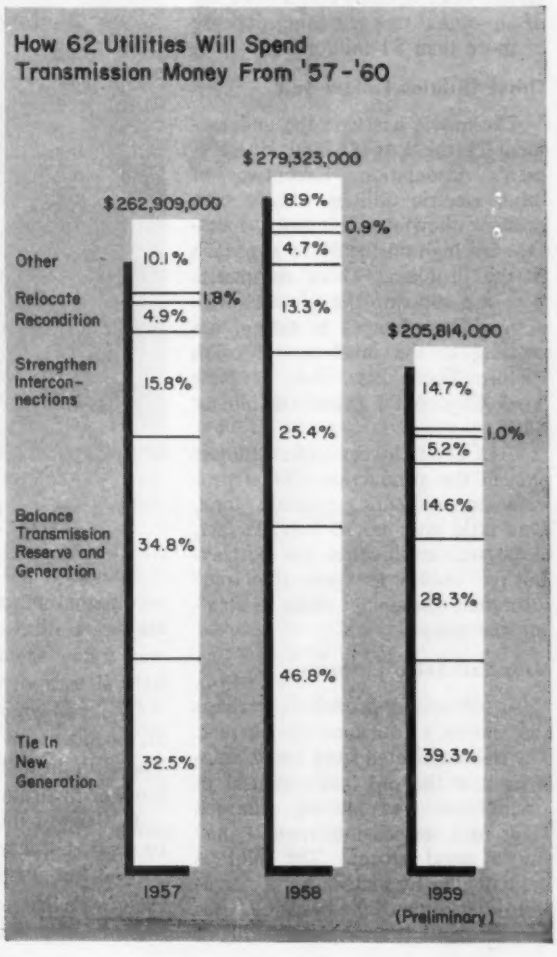
- **Spending for lines and rights-of-way will hit $1.3 billion from 1957 through 1959, based on survey of 62 Class I utilities**
- **Two thirds of the outlay will provide for tie ins to new generation, balance reserve**

With some 40 million kw of new generation to be dedicated by 1960, U. S. electric utilities plan to spend bigger portions of construction budgets for transmission lines and rights-of-way. A recent Electrical World survey indicates the industry will spend $1.3 billion on lines and R/W during 1957, 1958, and 1959, based on replies from 62 Class I utilities. This outlay represents about 8.6% of EW's forecast for $15.2 billion worth of over-all construction spending for the same period.

The survey covered only items already authorized and did not include substation allocations. These factors explain the difference between the $1.3 billion figure and the Sept. 2 forecast of $2.4 billion for total transmission construction.

More than two-thirds of funds allocated by the 62 utilities will go to tie new generation to the system and balance transmission reserve with generating capability. Another 20% will be spent on strengthening interconnections and reconditioning existing circuits. Line relocations, despite the impact of the federal highway program, will take only 1.2%. Most of the remaining 10% ("Other" in chart) is slated for lines that will serve new load and transmit bulk power.

Of 91 voltages mentioned, 66 to 69 kv will be used by 31% of the utilities. Those of 110-115 kv are planned by 25%. Twenty per cent will build from 132-138 kv; another 20% plan on 220-230. Four companies plan to build in the 330-345-kv range.



Movie Smooths Tree Trim Operation

LILCO film gets rave reviews from customers, nurserymen, and other utilities. After some 40 showings, fewer service interruptions and lower trimming costs appear definite

A movie on the importance of planned, orderly tree trimming—before wind storms inflict their costly damage—is producing a backlog of showing requests for Long Island Lighting Co. The New York utility is presenting the film about three times a week before civic, church, social, and to many school groups.

Called "Trees and Power", the 23-minute, color film has been shown about 65 times since its completion last winter. General reaction has been encouraging, the company says. And indications already point toward reduced numbers of service interruptions and a lowering of an annual tree trimming expense of more than $1 million.

Other Utilities Follow Suit

The movie has won the endorsement of the Long Island Nurserymen's Association. Executives of other electric utilities who've seen preview showings at industry meetings are high on the film's approach to the problem. Three companies now are showing the picture, with appropriate changes in titling, according to the producers, Motion Picture Techniques, Inc, of New York City. MPT prices the film at $205.

LILCO employees and customers star in the production. They provide an authentic, realistic tone. One little gray-haired lady, in fact, does such an effective job portraying the stubborn, "spare that tree" customer, she comes close to stealing the show.

Uses Soft-Sell Approach

A soft-sell approach is perhaps the movie's outstanding feature. The uncomplicated story line dramatizes how the old lady's refusal to permit her trees to be trimmed leads to a service interruption during a wind storm. The plot is augumented by pictorial and narrative description of the best tree types for residential areas, the skill of tree trimming experts, and the poker-faced, efficient workings of the utility during emergencies or outages.

Reduction of service interruptions was the main goal set by LILCO for the film, which Asplundh Tree Expert Co co-sponsored. By enlisting home owner cooperation, the utility can arrange orderly, planned trimming that finds tree crews making sweeps down blocks at a time.

How do viewers like it? Says one civic association man in a typical acknowledgement: "Once again you have proved to us that Long Island Lighting is a good neighbor with a genuine interest in our community." A Midwestern utility information director writes: "We had most favorable comments after a showing before district managers."

LILCO sends a company representative along to handle an hour or so of discussion after each showing. These sessions usually revolve around local aspects of the tree vs pole-line problem.

Big Spout Erupts at Big Geyser

Spouting 200 ft into the air this "Volcano" at Thermal Power Co's geothermal power project spread rock, ash, and mud over a wide Big Geyser, Calif., area last month. The big blow came as the rig seen here was trying to tap an underground steam pocket. The steam opened a natural escape route—called a fumarole—through the earth.

The wild geyser will not halt drilling operations, says Dan A. McMillan, Jr, president of Thermal Power, although the well has been abandoned. The firm brought in another well soon after the eruption, holding the number of producing wells at five.

If plans of the company work out, ten wells at the site will eventually be tapped. Steam will spin turbines at a proposed power plant for some 25,000 kw. Pacific Gas & Electric Co, to whom McMillan hopes to sell the power, has said that production of 12,500 kw would justify construction of a transmission line.

Struggle for the Snake Rages

In three-pronged attack, FPC staff, Hells Canyon Assn, and Oregon attempt to block development of Mountain Sheep-Pleasant Valley project by private utility group

The Federal Power Commission staff, National Hells Canyon Assn, and the state of Oregon have all attacked an FPC hearing examiner's decision favoring a license for Pacific Northwest Power Co to develop the Mountain Sheep-Pleasant Valley hydroelectric project on the Snake River in Idaho and Oregon.

These attacks came as the PNP license application moved another step forward in its more than two-year journey toward a final FPC decision.

PNP first applied for a license for the two-dam, $234-million project in September, 1955. The application has been contested all the way by National Hells Canyon Assn, representing a group of federal power supporting organizations.

Examiner Endorsed Private Plan

Last July, FPC Hearing Examiner Edward B. Marsh decided in favor of issuing the license to PNP on the grounds the proposed project is best adapted to comprehensive development of this stretch of the Snake. He added that development should not be undertaken by the U. S. government itself.

Previous to this the FPC staff had decided against issuing the license to PNP but had said that PNP should be allowed to apply for a license for a project at the Nez Perce site, farther down the river.

Flood Storage Factor Hit

In filing exceptions to Marsh's decision, the FPC staff again upheld its previous decision. It said that MS-PV would not provide adequate flood control storage and that Nez Perce would.

The staff contended that Nez Perce is superior in all respects to MS-PV and that it is economically feasible for PNP.

The Hells Canyon Assn and Oregon, in somewhat similar exceptions, asked FPC not to act on the PNP application at this time.

Oregon asked that action be withheld until March, 1959, in order that the state might complete its own study of the river. This study, which would be conducted by the state's resources board if the requested $50,000 is appropriated, is backed by Gov Robert D. Holmes.

In addition, the water resources board maintains also it has jurisdiction over the three middle Snake projects of Idaho Power Co. These projects are already licensed by FPC, with one—Brownlee Dam—under construction. The board said it would include the Idaho Power projects in its proposed study.

Defer Decision for Studies

The Hells Canyon Assn argued that no decision should be made until studies had been completed by Oregon and by the Army Engineers.

It also contended that:

- The proposed project would not provide maximum flood control and power development and therefore was not best adapted for comprehensive development of the river.
- That the examiner's decision showed less concern for public interest than it did for the interests of the four private utilities which are members of PNP.

Next step in the proceeding will be the full commission's decision.

D-Y Asks U.S. for $2 Million

The Dixon-Yates contract case has entered its final stages.

In a recent three-day hearing, Mississippi Valley Generating Co introduced evidence to support its claim that the controversial contract, cancelled by the U. S. government, was nevertheless "a binding obligation on the government." Hearings were held in the U. S. Court of Claims before Commissioner Wilson Cowen in New York City on Sept. 25-27.

MVG, a subsidiary of Middle South Utilities, Inc and the Southern Co, is suing the government for money spent on work during the period of the contract.

MVG had signed the contract with the Atomic Energy Commission to build a $107-million power plant at West Memphis, Ark.

The contract became effective on Dec. 17, 1954, although it was signed on Nov. 11, 1954. It was cancelled by the government on July 11, 1955, following an announcement by the City of Memphis that it would build its own plant.

The amount owed by MVG under the contract was originally $3.5 million, said Attorney John T. Cahill, of Cahill, Gordon, Reindel & Ohl, in his opening statement. MVG was able to bring this down in the neighborhood of $2 million. This difference was due to the fact that "all manufacturing claims have been settled without cost to MVG," Cahill pointed out.

Canaday Testifies for MVG

Paul A. Canaday, vice president of MVG, testified for MVG and W. H. Colquhoun, vice president of Ebasco Services, Inc, represented Ebasco, which was to design and construct the plant.

S. R. Gamer is representing the government.

Earlier Cahill had submitted evidence that the comptroller general and the general counsel of AEC both claimed the contract was "binding."

Hearings will resume in Washington, D. C., on Oct. 16, with the direct defense by the U. S. government.

AG&E's Cook Defends Amortization Program

Says an accelerated amortization certificate's value to utilities is wiped out in a year by fixed charges, leaving detriments that last on and on

A staunch defense of accelerated amortization, plus a stinging rebuke to those who use misleading figures to attack the program, was delivered recently by Donald C. Cook, executive vice-president of the American Gas & Electric Service Corp, at a meeting of the Public Utilities Assn of the Virginias in White Sulphur Springs, W. Va.

Cook pointed out that a utility's fixed charges wipe out in one year any advantage offered by accelerated amortization certificates, leaving utilities saddled in coming years with the certificates' disadvantages.

Furthermore, the value of certificates has been so exaggerated that "we are entitled to inquire into the motives underlying the exaggeration," he said.

Look Behind Smoke-Screen

He asked: "Is it possible that the charge is being made for political purposes and as a smoke screen to cover up and draw attention away from real and substantial subsidies received by those making the charges?"

He referred to charges that the accelerated amortization program constitutes a huge federal billion-dollar give-away. Specifically it has been charged:

- That through July 11, 1956, the electric utility industry received certificates for $3.1 billion of facilities. "This is true," said Cook.
- That this has resulted or will result in postponement of $1.39 billion in taxes. "This is only partly true," Cook stated. "It is entirely true only if comparison is made with straight-line depreciation and on the assumption that the program does not itself generate additional federal income taxes."
- That over a 33⅓-year period, the total "subsidy" amounts to $4.72 billion. "This is entirely and demonstrably false," he said.

"Presumably this amount is arrived at by taking the aggregate amount of the taxes postponed and adding 6% compound interest over a 33⅓-year period. This computation is entirely and demonstrably phony and was known to be phony at the time it was made," he said.

Here are the facts as Cook described them to PUAV delegates:

To build facilities the government needs for defense, the taxpayer must use his own money—the government contributes nothing. The certificate enables him to recover his own capital invested in the certified portion of the facilities over a five-year period. His taxes are reduced for the first five years, but are increased for the next 28⅓ years. His total taxes are the same as they would have been if facilities had not been subject to fast amortization.

The benefit, if any, to the taxpayer amounts to the certificate value less its detriments.

Cook pointed out that the value of a certificate is 13.6% of the amounted certified. But he said a utility's fixed charges are over 14% a year.

New PUAV Officers

The PUAV elected the following officers: John C. Parrott, president of Roanoke (Va.) Gas Co, president; Hugh D. Stillman, division manager of Appalachian Electric Power Co, first vice-president; H. Atwood Hitch, vice-president of Virginia Electric & Power Co, second vice-president; William F. Keehne, system office manager of AEP, treasurer; Arthur T. Ellett, secretary-treasurer of RG Co, assistant treasurer; and Robert W. McKinnon, executive secretary. The last three were re-elected to their previous posts.

FPC Reports 564.3 Mw Net Capacity Gain

PLANT ADDITIONS DURING JULY

State	Utility	Plant	Fuel	Capacity
Del.	Delaware Power & Light Co	Delaware City	S	50,000
Ga.	U.S. Army Engineers	Buford	H	6,000
Ga.	U.S. Army Engineers	Buford	H	40,000
Ill.	Mount Carmel Public Utility Co	Mt. Carmel	S	7,500
Iowa	Atlantic Municipal Utilities	Atlantic	S	5,000
Kan.	Western Light & Telephone Co	Ft. Dodge	S	16,500
Mass.	Western Massachusetts Electric Co	W. Springfield	S	100,000
Mich.	Allegan Board of Public Works	Allegan	IC	2,720
Miss.	Mississippi Power Co	Gulfport	S	75,000
Mo.	Carthage Water & Electric Plant	Carthage	IC	4,200
Mo.	Springfield City Utilities	James River	S	22,000
Mo.	Malden Light & Water Dept	Malden	IC	1,360
Neb.	Wilber Electric Dept	Wilber	IC	900
N. M.	Southwestern Public Service Co, Pecos Valley Div	Cunningham	S	70,000
Tenn.	U.S. Army Engineers	Old Hickory	H	25,000
Va.	Virginia Electric & Power Co	Yorktown	S	150,000

RETIREMENTS

Fla.	Jacksonville Dept of Electric & Water Utilities	Talleyrand	S	4,000
Ill.	Mount Carmel Public Utility Co	Mt. Carmel	S	1,500
Mo.	Springfield City Utilities	Main Street	S	400
Neb.	Syracuse Municipal Water & Light Plant	Syracuse	IC	820
Nev.	Sierra Pacific Power Co	Battle Mt.	IC	384
N.Y.	N.Y. State Electric & Gas Corp	Owego Upper	H	360
Ohio	Cincinnati Gas & Electric Co	St. Bernard	S	4,000
Ore.	California-Oregon Power Co	Keno	H	760

U. S.	Hydro	Steam	IC	Total
Added	71,000	496,000	9,180	576,180
Retired	1,120	9,900	1,204	12,224
Adjustments Plus	8,100	.....	4,553	12,653
Adjustments Minus	50	12,130	130	12,310
Net Change	77,930	473,970	12,399	564,299

H—Hydro, S—Steam, IC—Internal Combustion

United States Capacity as of August 1—Hydro, 26,424,509 kw; Steam, 96,088,810 kw; IC, 2,479,39 kw; Total, 124,992,712 kw.

Following EEI's 'how to' sessions . . .

Plans Laid for Education Push

An all-out program aimed at educating employees through an effective industry-wide communication system is in the planning stages by Edison Electric Institute.

Such a program, in which every feasible communication channel would be used, was introduced at the Tenth Annual Round Table Conference of Edison Electric Institute's Industrial Relations Committee which met in Chicago.

Bulwark Against Collectivism

"A well informed core of employees" said EEI Vice President Edwin Vennard, "satisfied with their company's policies and aware of the part they and their company play in the American economic system, will not only form an effective line of defense against the threat of collectivism, but will also perform an invaluable public relations function."

He said that the industry should present a simplified course in the economics of the American system to its employees. This course should point out, he continued, that individual freedom is essential to any sound economic structure. Once employees understand this, he declared, it becomes relatively easy for them "to see the basic flaws in any socialistic program."

If we fail in our struggle against the forces of collectivism, he said, our defeat will result in much more than just government operation of the power business. It will result in the loss of everything that makes America what it is. It will result in the end of liberty and freedom in this country and it will result in the finish of our country as the richest, most progressive nation in the world, he concluded.

We need to properly "tell our story" and have it completely understood by the employees, is the way W. O. Turner, president, Louisiana Power & Light Co, put it.

Supervisory Chain Reaction

He also pointed out the importance of improving the quality of supervision. This, in turn, will achieve better employee relations with a corresponding improvement in production. It also will create more understanding among customers and public power groups toward the industry and its problems, he said. Most people call it "communications." Like the weather, we do a lot of talking about it, but too often our efforts are in the token of lip service category, he observed.

Look for and choose more effective and positive ways of communicating with the supervisors and through these supervisors to the other personnel, Turner concluded.

The force of any communication, said J. W. McAfee, EEI vice president and Union Electric Co president, is greatly affected by the personal relationships between the sender and the receiver. Leadership element is an important item.

EEI Plan Readied

To help get good communications, he said, "EEI is now working diligently and expects shortly to be able to submit to the industry a carefully considered program for employee information." He expressed confidence that there will be a great deal of interest in the program and that much effort will be given to making it as good and as effective as possible.

Four keynote speakers kicked off the conference with the theme "Enlarging Employee Effectiveness." Each of the keynoters covered one phase.

The four phases and the keynoters were:

- Communications — George Fewkes, Philadelphia Electric Co.
- Developing Morale and Loyalty —R. B. James, speaking for C. H. Campell, Pacific Power and Light Co.
- Training and Development— Donald A. Bartlett, Western Massachusetts Electric Co.
- Utilizing the Work Force— Frank J. Gleeson, Northern States Power Co.

Big Operating Turnout

Later, over 300 management representatives in the electric utility industry discussed these day-to-day problems in "how to do it" conferences. Of the persons attending, 40% came from the operating end of the business.

Edw. J. Brill, director-employee relations, Pennsylvania Power & Light Co, is chairman of Edison Electric Institute's Industrial Relations Committee.

Frank Osta, vice president, Niagara Mohawk Power Corp, was chairman of the 1957 Annual Round Table Conference Committee. Other members were: H. F. Carr, Pacific Gas & Electric Co, M. F. Osterling, Hartford Electric Light Co, C. E. Parker, Commonwealth Edison Co, C. R. Stockhus, Union Electric Co, and E. A. Werner, Gulf States Utilities Co.

Point of View on Profits

National Rural Electric Cooperative Assn has issued a research pamphlet purporting to prove the government has made money from rural electrification loans and an interest rate increase is unjustified.

Authored by NRECA's Paul Nelson and Clay Cochran, the pamphlet claims NRECA is not seeking any special privilege or subsidy for its members. But the authors state they are absolutely opposed to any interest rate increase.

The hard money policy, they add, "is a contrived policy, a conspiracy entered into by the Secretary of the Treasury, the Federal Reserve Board, and the spokesman of the various vested interest groups who benefit from the high interest rates created by this policy."

For "the first time," they charge, the power companies, banks, insurance companies, and the Eisenhower Administration are all united in demanding higher interest rates.

Cost Cutting Complication

Booz, Allen & Hamilton, city management consultants, conducted a recent study of Seattle Lighting & Water Department operations. The consultants recommended consolidation of planning, engineering, and other functions of the two departments. This and a halt of free service on electric ranges and water heaters would achieve savings of about $1 million.

But, encouraged by City Light workers, housewives began bombarding city council with baskets of mail protesting any change in the 30-yr-old policy of free service. The council quickly yielded to the pressure and rejected the proposal to charge for the labor involved in range and water heater repairs.

Canine Cacophony

Under a London dateline comes this dispatch: Every time someone telephoned a city housewife, the bell failed to ring but the dog in the backyard started barking. Engineers were called in. They found the phone lines shorting on the iron post to which the pooch was tied. When the circuit was made the buzz went to the dog instead of the bell.

TVA's 'Darndest' Promise

Arnold R. Jones, sworn in last month as the second Republican director of Tennessee Valley Authority, pledged he would do his "darndest" for TVA. Observed Sen Albert Gore upon hearing the remark: "To that, I say good." The Tennessee senator missed the ceremonies when a driving rain slowed his auto enroute from Carthage.

Jones, when asked what he thinks of his chances of confirmation when the Senate reconvenes, said he had not "thought a great deal about it." He said he prefers the Kerr bill, passed in modified form by the Senate, for TVA financing to the Administration-backed measure.

A week earlier, Joseph C. Swidler, top TVA counsel for 12 years, resigned to let "the new board make its own selection of a general counsel."

Meanwhile, new names were added to the growing list of possible candidates for the third TVA director post. Dr. C. E. Brehm, University of Tennessee president, and Lawyer Ralph W. Gardner, son of the late Gov O. Max Gardner, North Carolina, are two that were mentioned. Both are Democrats.

Engineer HQ on UN Plaza

The new engineering headquarters in New York City for five engineering societies will be situated on the entire block front on the west side of First Avenue between 47th and 48th Streets.

United Engineering Trustees, Inc, representing five national engineering societies including American Institute of Electrical Engineers, paid $2.7 million for the land. The site is in a section of First Avenue known as United Nations Plaza. The new quarters will replace a 16-story center at 29 West 39th Street, built in 1906.

Electrical Week Down Under

Australians launch their own version of an electrical week this Wednesday. Timed for the advent of "down under" spring weather, the observance will be called "Live Better Electrically Week". It is sponsored by South Australia's Electrical Development Assn.

In the U. S. last February, National Electrical Week was promoted in 40 states, five Canadian provinces, District of Columbia, and Hawaii. The next observance is Feb. 9-15, 1958.

Staying Atop the Boom

To keep ahead of "phenomenal" growth in its service area—particularly the increasing industrial load in Albuquerque—Public Service Co of New Mexico is stepping up construction schedules. Completion date for the first of four 49,000-kw capability units of the Reeves Station has been moved up six months for May, 1959, operation. Stearns-Roger Mfg Co of Denver is contractor for the project.

The faster tempo means that within the next 13 months the utility will have added almost 70% to its generating capacity. PS started last week on a $2-million, 115-kv line from Albuquerque to Sante Fe where it will tie in with an Atomic Energy Commission line to Los Alamos.

"A man died this way." The author shows his rig that saves lives by . . .

Demonstrating the Live Line Hazard

JAMES R. THOMPSON, Ass't System Safety Director, Kentucky Utilities Co, Lexington, Ky.

Kentucky Utilities Co has made long strides in safety training with an apparatus that shows vividly the hazards inherent in live power lines. More than 100 demonstrations of the "Live Line Hazard Demonstrator" have reached nearly 14,000 people in the past three years.

The need for a way to train utility employees and educate the general public on live lines is proclaimed by the 1,000 deaths every year caused by electric shock and burn accidents.

KU makes safety stick by demonstrating how some of these accidents happened.

The "Demonstrator" looks like an elaborate child's toy. Models of a house and a substation sit on its 10-ft stage. Transmission lines run across the back, and the kindergarten picture is rounded out by a small crane, a fire truck, a line truck, and several cars.

But it is far from a toy. A power pack transformer energizes the line at 15 kv with 30 ma to back it up. This is enough power to arc several inches when a little metal man is pushed into the lines.

The demonstration lasts about 45 minutes, and consists of 15 dramatic reenactments of fatal electric shock and burn accidents that have occurred in the KU service area. The actual contact with energized equipment is dramatized with either a neon "Reddy Kilowatt" figure, which glows brightly when energized, or a metal lineman who draws a 4-in. arc.

Two of the accidents appear at right. Here are a few others:

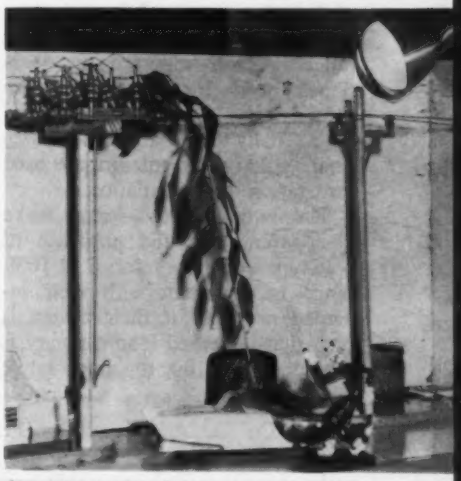
A minister who was trying to move a fallen primary contacted it with his foot. In the demonstration *—the metal lineman makes contact with fallen wire and draws arc.*

A baby while being bathed in the kitchen sink reached up and touched a defective fluorescent light fixture *—"Reddy Kilowatt" touches fluorescent fixture and glows brightly.*

A district crew was setting a pole in a primary line with ground wire attached to the truck. The pole touched the primary and a lineman touched the body of the truck—*Metal lineman touches truck, drawing a large arc.*

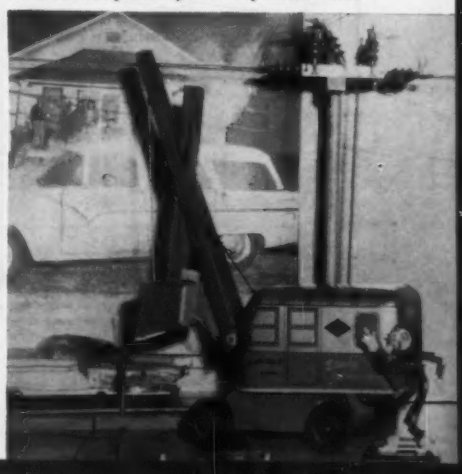
A boy was flying a kite in the rain. The wet string sagged enough to touch a primary line—*"Reddy Kilowatt" holds kite string and glows as it falls across the hot line.*

The demonstration emphasizes that electricity is safe when properly handled. But it shows forcefully that it must be treated with respect.



SIZZLING LIMB electrocutes man who touched car it connected to live line

CRANE BOOM became a bus bar when it contacted primary line. Operator died



How to Get More from Distribution

Limit their range to less than full regulation, and they provide increased load capacity. It means more flexibility

H. A. **ENOS**, Manager (retired), Distribution Engineering Section, American Gas & Electric Service Corp, New York, N. Y.

R. L. **BROWN**, Manager, Substation & Tap Changer Engineering, Transformer Division, Westinghouse Electric Corp, Sharon, Pa.

Distribution regulators are much more flexible for application to various circuit requirements as the result of their ability to carry more than normal current when limited to less than full regulation. Ability to limit the operating range of the regulator makes additional current capacity available (Table I).

A recent survey of all EEI member companies indicates that most of them have no need for pole-type regulators with more than 10% range. A few reported an occasional need for regulators with greater range. Such needs however, were usually temporary, or for cases where pole-type regulators are used for station bus regulation.

The findings of this survey make it apparent that the purchase of pole-type regulators for a ±10% range is consistent with their intended use only if their design is such that increased load capacity is provided when the regulator range is limited to less than 20% total. Such a load range feature has been previously available in regulators having a total range of 10%.

Capacity of a regulator is determined by its full buck and boost position and the full load line current. If a regulator is operating at only half range as boost or buck, the kva passing through it is only half of that at full boost or buck. Then the current in the common winding is only one-half; current in the series winding is the same, but only half of this winding is in the circuit. Therefore, the regulator has inherently higher load capability at any buck or boost position below maximum.

160% Current at Half Range

If limited to one-half normal range a distribution regulator, with very little change in design, can carry 160% of normal full-load current. Regulation range limits are provided by limit switches associated with the position indicator. These switches can be adjusted to limit the buck or boost range independently in 2½% steps.

The application engineer now has a much easier time in applying these regulators, because from a standard line he has full 20% range where required. For most applications, however, he can limit the regulator's range to carry more than the normal rated current at full range (Table II).

Voltage variation at any point on a system is caused by voltage drop. Therefore, to determine permissible drop, it is necessary to examine voltage profiles from the source to the last customer's appliances.

A voltage profile (Fig 1) for a feeder supplied from a regulated source shows the maximum voltage drop at the end of the line required to keep above the minimum voltage at the customer's appliance. In a 120-v nominal voltage system the minimum voltage at an appliance should be 110 and the maximum 125 v. It is generally found most economical to limit the full-load drop from the primary of the distribution transformer to the customer's appliance to 8 v, thus requiring the minimum of 118 v at the primary of the transformer.

As the maximum voltage at the appliance of a customer nearest the regulated source should not be more than 125 v, the maximum voltage at the regulated primary source should not generally exceed 126 v. With a 2-v band width at the regulated source the bottom of the band is 124 v. This allows only a 6-v drop in the primary line to the primary of the last transformer.

Table I—
Limiting Voltage Range Increases Current Capacity

Voltage Regulating Range in Percent (Raise)	(Lower)	Current in Percent of Normal Rating
10	10	100
8¾	8¾	110
7½	7½	120
6¼	6¼	135
5	5	160

Table II—Regulators Have These Voltages and Kva Ratings

Line Voltage Single Phase or Line to Neutral 3 Phase	Circuit KVA Limit 1 Phase	Maximum Current Rating of Regulator at +10% Reg.	Maximum Current at ±5% Reg.	Remarks
2,500	1,000	400	500	Current rating limited by the tap changer
5,000	1,000	200	320	Current limited by winding capacity at 55C rise
7,620	1,670	219	350	Current limited by winding capacity at 55C rise
13,800 Δ only	1,380	100	160	Current limited by winding capacity at 55C rise
14,400 for 24,900 Y.	1,440	100	160	Current limited by winding capacity at 55C rise

Regulators

The source of the line may be an unregulated bus at a distribution station. In this case the regulator must have a range adequate to compensate for transmission line voltage variation at the bus plus the voltage drop in the feeder. The required range may be large, but on many systems it is less than 10%.

Fig 2 is a typical example of a regulator placed in a feeder, the source of which is an unregulated bus. In this case a regulator with a 7.8% boost is adequate to maintain the minimum voltage at the end of the line.

A ±10% regulator with limit switches set at ±5% can be used at this location if the substation no-load tap changer is set to boost the voltage 5% above normal at no load. The regulator then bucks the voltage down to normal at no load and gives an additional boost of 2.8% at full load to keep the minimum voltage within acceptable limits.

Maintaining Voltage Level

Often utilities are confronted with situations where the station bus is regulated, but the voltage drop on the primary line is considerably more than 6 v out to the last transformer. In such cases the proper voltage level can always be maintained more economically by pole-type regulators than by increased conductor size.

Even if load growth requirements are ignored and the regulator is placed where the voltage falls to 118 v, the maximum at that point will usually not exceed 125 v. This is a variation of 7 v, or 5.6% at 125-v median output. A regulator having 10% range is more than adequate for such an application.

Fig 3 is typical of the case where voltage sags too low at full load at the end of the line. A regulator installed initially at position A with limit switches set at ±5% regulation will take care of the voltage until the load has grown to 160% of initial full load. This value is presumed to be the basis upon which the regulator rating was selected.

When this regulator can no longer handle the load because of growth, a larger regulator can be installed

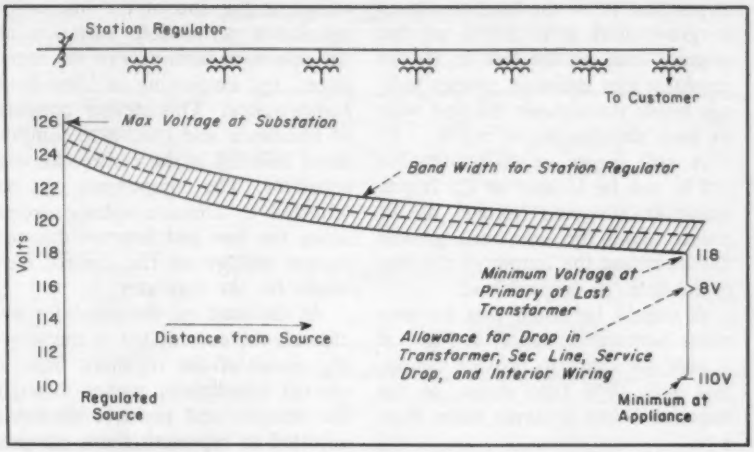


FIG 1—VOLTAGE PROFILE for a feeder supplied from a regulated source but without a line regulator shows the maximum voltage drop permissible at end of the line to keep above the minimum voltage required at customer's appliance

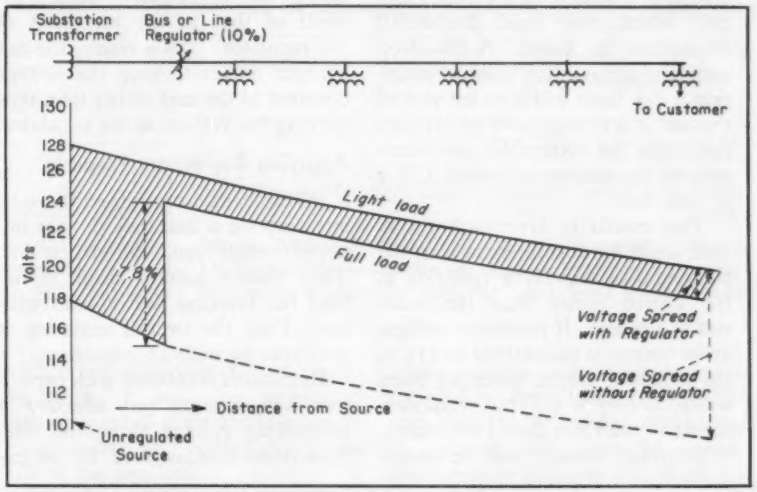


FIG 2—TYPICAL EXAMPLE shows the effect of placing a regulator in a feeder which has an unregulated bus as its source. Regulator set at 7.8% boost is adequate to maintain the minimum voltage required at the end of the line

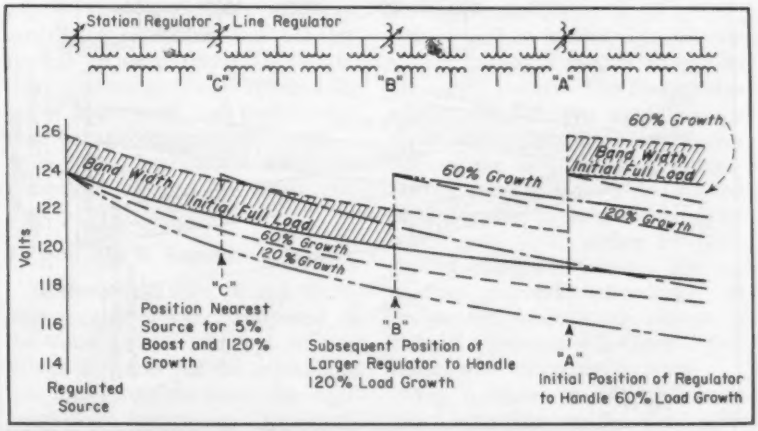


FIG 3—SUCCESSIVE REGULATORS, set at ±5% to take advantage of higher load capacity, can be added to line to permit 60% load growth each. On adding regulator "C," adequate voltage has been maintained at 2.2 times original load

at position B. If the load continues to grow until it is 220% of the original load on the line at B, the regulator can maintain proper voltage levels throughout the line with its limit switches set at ±5%.

A still larger regulator set for ±5% can be located at C. It can maintain adequate voltage at all points along the line until growth has increased the output of the line to 2.2 times its original load.

If should be noted that for any point between A and C in Fig 3 it is only necessary to provide regulators with 10% total range, as the required boost is never more than 6 v.

Using Line-Drop Compensator

In some cases a regulator is installed at a station on a primary circuit which has load distributed throughout its length. A line-drop compensator is often used to maintain a 2-v band width at the end of the line at a voltage level which does not cause the voltage for customers nearest the station to exceed 125 v at full load.

This results in lower voltages at light loads for customers nearest the station, with maximum variation at the source rather than the outer end of the line. If minimum voltage at the source is maintained at 118 v, the regulator range, including band width, is only 8 v. This requires a regulator with less than 10% range.

Constant voltage can be maintained at the end of the line, with maximum permissible variation at the source or terminals of the regulator, by employing a line-drop compensator. This device consists of resistance and reactance components inserted in the control for the regulator. The components can be adjusted to simulate voltage drops along the line and impress this resultant voltage on the control elements for the regulator.

As the load on the regulator increases, the current fed to the sensing circuit of the regulator from a current transformer passes through the reactive and resistive elements adjusted to represent these components in the line.

The voltage sensing element therefore "sees" a voltage comparable to that at the end of the line instead of that at the terminals of the regulator. As a result, the tap changer moves to keep the voltage constant at the end of the line, thus varying the voltage at the regulator.

Applying Capacitors Properly

Where capacitors correct the voltage drop on a line they do not improve overall regulation of that line. They reduce voltage drop at full load but increase the no-load voltage. Thus the overall variation is the same as without capacitors.

Regulators combined with capacitors, however, are very effective in controlling voltage along the line. This point is illustrated by an example (Fig 4) where capacitors are at the end of the line to increase the voltage at full load.

With capacitors only, the spread in voltage from no load to full load is outside the tolerable limits. However, with the regulator added at a point along the line, the voltage spread is reduced to acceptable values.

The function of a regulator is to maintain as nearly as possible a constant voltage at its terminals or, if line drop compensation is used, at some point in the line. Obviously, there are limits to the precision with which a voltage can be maintained without excessive operation of the regulating device. It is desirable, therefore, to set limits on each side of the desired voltage within which the control of the regulator does not initiate a change in voltage. This area (shaded on Figs 1 to 4) is called the band-width setting for the regulator.

The voltage sensing relay, whether it be a balanced-beam, induction-disk, or static device, does not close contacts until the voltage has departed by one-half the band width from the balance voltage setting. In most cases a time delay is introduced after closing the relay contacts. This feature delays any corrective action of the regulator until the change in voltage has become permanent, or at least beyond the time delay setting.

This means, of course, that the voltage may continue to move away from the balance voltage during this time delay period. The time delay, usually adjustable, is selected to give satisfactory voltage control without too many operations of the regulator.

Band Width Adjustable

Band width is also adjustable. Obviously, the narrower this bandwidth setting, the more accurately the voltage may be held to the desired level. There are definite limitations, nevertheless, in this rule because the narrower the band width, the greater the number of operations of the relay and tap changer, unless the time-delay setting is very large.

Surveys indicate that ±1-v band width is the minimum used and that many users prefer band width of ±1½ v. The reason, of course, for these large values is that smaller

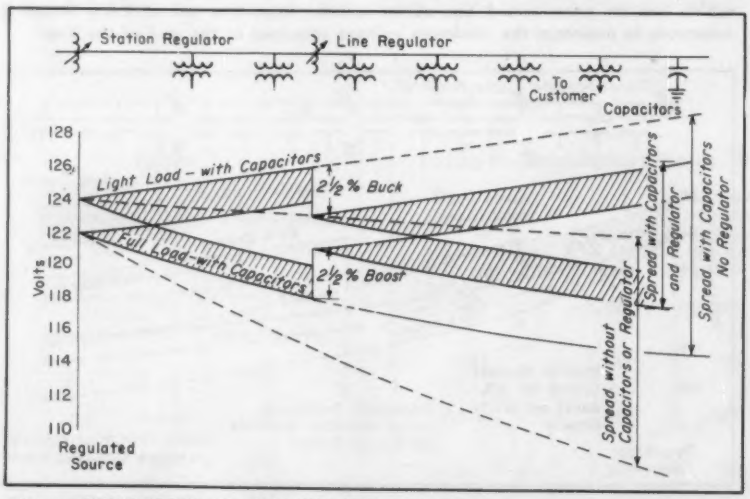


FIG 4—REGULATORS IN COMBINATION with capacitors are very effective in controlling voltage along the line. Here, capacitors at end of line increase voltage at full load. But with capacitors only, voltage spread is too wide

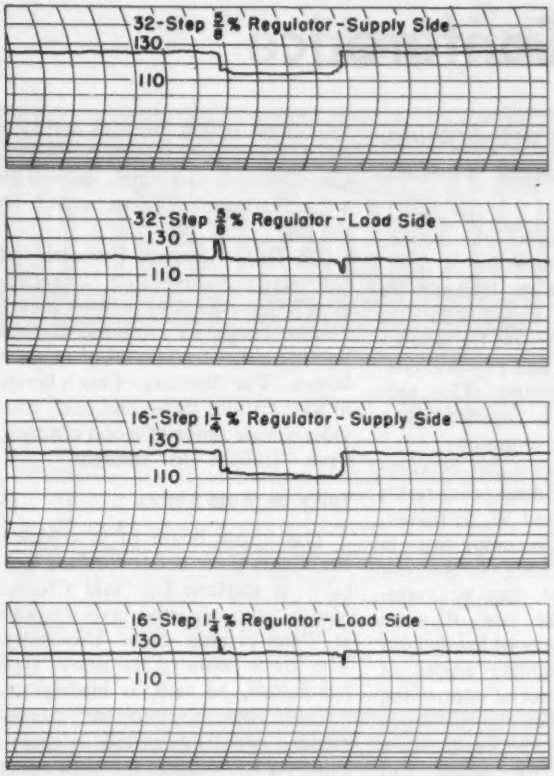


FIG 5—WHERE SYSTEM DISTURBANCE is caused by sudden change in supply voltage, 16-step 1¼% regulator restored load voltage much faster than the 32-step ⅝% regulator

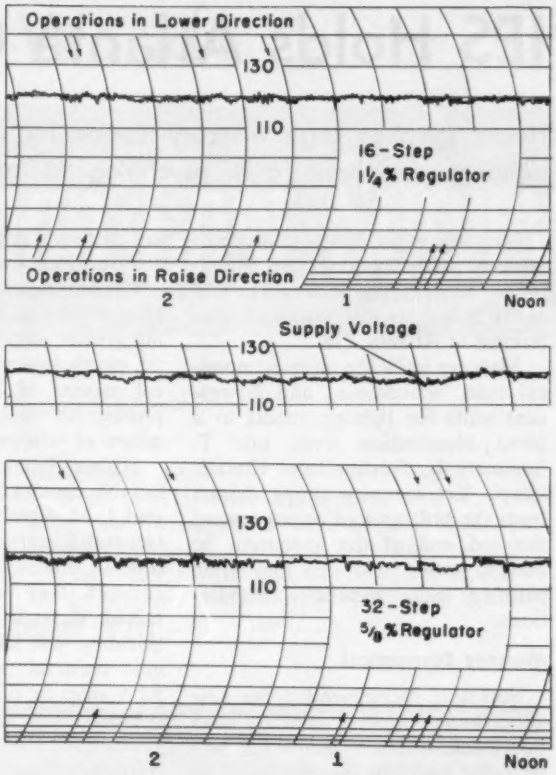


FIG 6—WHERE SUPPLY VOLTAGE varied rapidly, 16-step 1¼% regulator held narrower effective band width than the 32-step ⅝% regulator with the same band width setting

values would cause excessive number of operations of the relay and tap changer without accomplishing the overall better regulation on the line.

As a band width of ±1 v has been found the practical minimum for satisfactory operation, apparently the size of step taken by the regulator should be as large as possible within this band.

With ⅝% steps (¾ v on 120-v base) more than one step is required to correct the voltage to the balance point without exceeding the limits of band width. With 1¼% steps (1½ v on 120-v base) it requires only one step of the regulator to bring the voltage back. With a general drift in voltage the operation of the tap changer is only one-half as often as where ¾-v steps are used.

When the line of distribution regulators was developed, careful consideration was given to all factors influencing the size of step. It was recognized that the steps must be small enough to avoid lamp flicker and interference with TV and radio reception. It was also recognized that very small steps would increase maintenance and reduce the useful life of the regulator.

A series of field tests lasting more than a year was made on three different systems to check theoretical conclusions reached in the laboratory. These conclusions held that quality of regulation was not improved by steps under 1¼% and that maintenance was reduced by use of larger steps. Lab tests showed that voltage changes up to 1½ v on a 120-v base would not cause noticeable changes in lamp brilliance.

⅝ and 1¼% Regulators Tested

In these field tests ⅝ and 1¼% step regulators were compared on the same and on identical circuits. Where it could not be established that loads were the same, the regulators were interchanged frequently to make sure that correct conclusions were reached.

Fig 5 and 6 are typical of the many records taken which compare the quality of regulation of ⅝% 32-step and 1¼% 16-step regulators. In each of these cases the regulators were on different phases of the same 3-phase supply voltage.

The 1¼% step unit held the 2-v band width as well in every case investigated as several makes of 32-step regulators.

In Fig 5, a disturbance on the system caused a sudden change in the supply voltage. The 16-step regulator restored the load voltage much faster than the 32-step units because the induction disk voltage-sensing relay used with the 16-step regulators has an inverse time delay which gives faster action for large sudden changes in voltage. The tap changer responds immediately to the control when a tap change is called for because it is Geneva-gear driven with no springs to wind.

Fig 6 shows a supply voltage which is varying rapidly. The 1¼% regulator held a narrower effective band width than the ⅝% unit with

(*Continued on page* 192)

IES Holds Atlanta Conference

Hears speaker urge mercury lamps for street lighting; lighting's aesthetic and psychological aspects stressed

Mercury vapor lamps afford economical street lighting, the Illuminating Engineering Society was told at its recent annual technical conference at Atlanta, Ga.

Mercury units are more economical than incandescent and fluorescent units for lighting streets to a given illumination level, said T. Summers Jr, Westinghouse Electric Corp. Yet mercury lamps detract from the brilliance of colors toward the red end of the spectrum, he added, noting that this loss often justified more expensive installations.

Mercury Economical

Summers recommended the new silver-white colored mercury and fluorescent-mercury lamps for better color rendition, accompanied by the inherent economy of the mercury source.

Horizontal large-lamp luminaires, containing 250 and 400-w mercury lamps are best for denser-traffic streets through residential areas, said John W. Young, New England Power Service Co. When these lamps are at 200-ft intervals and at light-center heights of 31 to 32 ft, he said, lighting levels up to 0.8 ft-c average are obtained and distribution is uniform enough for a high degree of silhouette lighting and direct discernment.

Experience, said Young, shows that the 100 and 175-w units used for other residential streets require a high vertical angle. A 77 to 79-deg angle, suitable to the frequent practice of spacing smaller lamps at 200 ft, is applicable also to 250-ft spacing. But trials with coated lamps, he added, suggest that the vertical angle can be lowered about 3 deg.

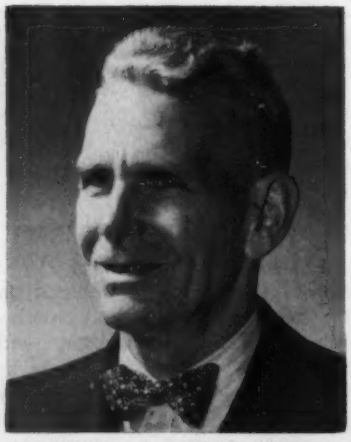
Illumination and acoustical engineers today are competing for ceiling space, said George W. Clark, Sylvania Electric Products, Inc. He urged illumination engineers to acquire enough knowledge of architectural acoustics to cooperate in securing the benefits of good lighting without impairing the proper acoustical environment.

Clark joined with Richard E. Harz of the same company in urging greater emphasis on the aesthetic, psychological, and psychophysical aspects of lighting. This emphasis, he said, is needed as a means of relieving monotony.

Higher illumination can be comfortable enough for most office tasks, said J. M. Ketch and W. S. Fisher, General Electric Co, citing tests in several offices. Good direct-view comfort, they said, can be maintained through the use of more shielding with louvers of low-brightness material (shielding angles of 52½ deg) or of special controlling reflectors and louver shapes. They pointed out that the IES reflectance recommendations for room and work services, based on 50 and 100-ft-c installations, are satisfactory also for several hundred foot candles.

Gives Mood Changes

When a room with a luminous ceiling of fluorescent lamps cannot be cooled to a comfortable temperature by the circulating air, a cooling system installed above the ceiling can remove heat from the lighting equipment before it enters the room, said Walter Sturrock and Lester F. Schutrum, General Electric Co. Coils of cold water, as well as a circulating-air system, could do the job.



KIRK M. REID, General Electric Co, became IES president on October 1

Dr. D. E. Spencer, University of Connecticut, advocated a series-parallel arrangement of 30-v incandescent lamps for luminous ceilings lighting either traditional or modern homes. The dimming of such lamps in five distinct steps, she said, provides a wide range of mood changes, from "firelight" to "sunlight."

Talks on Auto Lights

The upper beam of a vehicle's headlights gives better forward visibility in daytime fog, said Charles Marsh, who reported investigations at Pennsylvania State University. The lower beam of the newer type headlamps, he said, is inadequate.

For night fog Marsh recommended headlights as low as practicable on the vehicle, the light being projected in a thin layer close to and parallel with the road's surface. This arrangement, he said, give low brightness on the pavement and high brightness on objects on or beside it. He suggested the use of two clear or white 30-w, PAR-36 fog lamps hung below the bumper.

Reid Is New President

The nomination of Kirk M. Reid, General Electric Co, as IES president, beginning Oct. 1, was confirmed at the conference. Joe B. Broder, Georgia Power Co, and James R. Chambers, Appleton Electric Co, were named vice president and treasurer, respectively.

The society's highest honor, the Gold Medal Award, was given to Prof John O. Kraehenbuehl, Colorado College. The award was recognition of "his far-reaching effect on the techniques of illumination in his long academic career and his personal sacrifices in promoting the nation's general welfare through teaching the importance of scientific lighting." E. P. Fortier, Electric Supply Co, and H. J. Poehling, Lauth & Associates, received awards for their papers, respectively, "Lighting of a New Orleans Penthouse" and "St. Louis Municipal Airport."

Electrical World's

10th Steam Station Cost Survey

JOHN J. KEARNEY, Assistant Managing Technical Editor

Producing power in modern steam power plants in 1956 cost more than it did in 1954. How much more than in previous years can be seen from figures in the table below. One should proceed with caution in attempting to draw definite conclusions from these average figures. But the cost increases shown should not come as a total surprise in view of the inflationary trends of the past several years.

When studying these data it might be well to consider that the impact on costs of large cross-compound units and supercritical pressures has not as yet entered into the calculations. Introduction of these advances in technology will most certainly affect energy costs in the future.

	10th Survey	9th Survey	8th Survey
For plants operating in . . .	1956	1954	1952
Average Busbar Energy Costs (mills per net kwhr)	7.15	6.30	6.25
Average Construction Costs-excluding swyd (dollars per kw)	146	131	133
Average Production Costs (mills per net kwhr)	3.25	3.10	3.50
Fuel Costs, portion of production costs (in percent)	83.0	83.0	80.0
Average Annual Plant Factor (in percent)	69.0	71.6	70.0
Average Utilization Factor (in percent)	103.0	106.4	105.0
Predominant Steam Cycles (steam pressures and temperatures)	1,800 psi 1,000F/1,000F	1,800 psi 1,000F/ 1,000F	1,400 psi 1,000F
Use of Reheat (percent of total capability reported)	80.0	55.0	39.0
Manpower Requirements (operating & maintenance employee per Mw)	0.37	0.50	0.62
Auxiliary Power Requirements (percent of gross generation)	6.0	6.0	6.0

Busbar Energy Costs Have Increased

• Average cost runs about 7 mills per net kwhr. Station size shows slight influence on cost

The average new steam power plant produced electricity at a cost of slightly more than 7 mills per net kwhr in 1956. In 1952 (EW, Eighth Steam Station Cost Survey, July 13, 1953) and in 1954 (EW, Ninth Steam Station Cost Survey, Oct 17, 1955) average energy costs were between 6 and 7 mills net per kwhr.

Low Fixed Charges for Some

Four stations actually provided electricity at a cost of less than 3 mills per net kwhr. But in each case the stations had low fixed charges resulting from charges for depreciation only. A closer analysis indicates that 63% of the reporting stations had a total cost of energy at the busbar of 8 mills per net kwhr or less, 40% 7 mills or less, (in 1955 it was 60%) and 28% 6 mills or less.

No smooth trend curve could be developed to show decreasing energy costs with an increase in station size. It was quite evident, however, that size did have some influence because energy costs in stations with 150-Mw of capacity or more averaged 5.5 mills and smaller stations had an average energy cost of 9 mills per net kwhr.

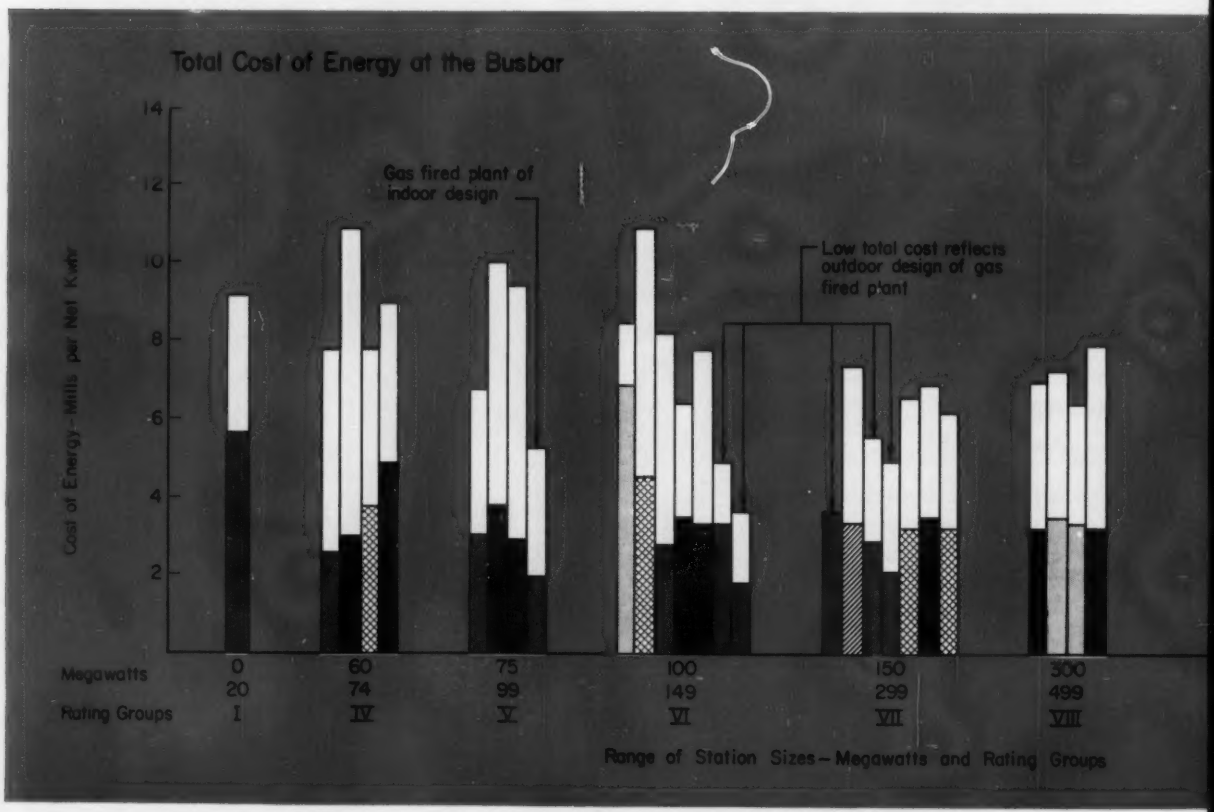
Wide Range in Investment Charges

Plant factor, investment charge, and plant location were the major determining factors in busbar costs. Consider investment charges—the percentage used in computing them ranged from about 2.8% for a public power agency to 17.5% for a private utility. This is a range of almost 6½ to 1. Investment charges were computed at an average percentage of 11.5. But this is deceiving because of the extremes cited above. A more representative figure would fall between 12 and 15%. A little less than three quarters of the participants in this survey used a percentage for investment charges within this range.

The influence of plant location can be seen by considering a breakdown of energy costs according to geographical location. The highest costs were in the New England area where the average reached 9 mills per net kwhr. The Middle Atlantic and East North Central regions followed closely with average costs of 8.8 and 8.4 mills, respectively.

Cost Lowest in East South Central

The rest of the average costs, in decreasing order, are South Atlantic region, 7.3 mills; Mountain, 7.2; Pacific, 6.5; West South Central, 6.2; West North Central, 5.8; and East South Central 2.7. These figures should be used cautiously, though, because dividing the plants



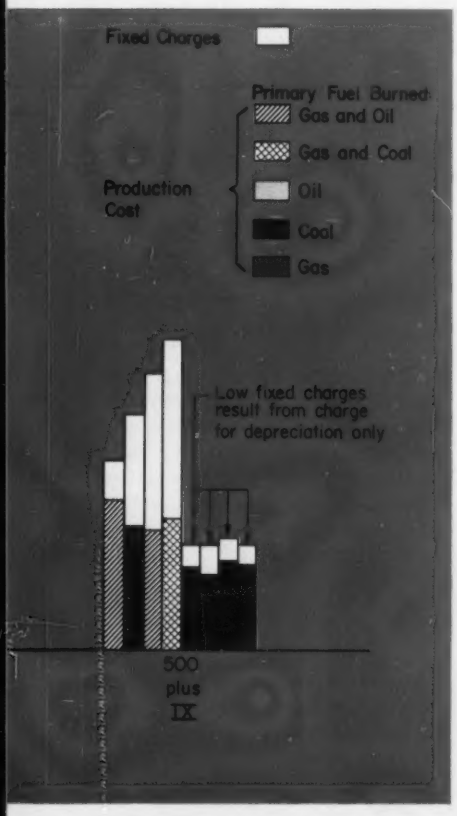
Slightly

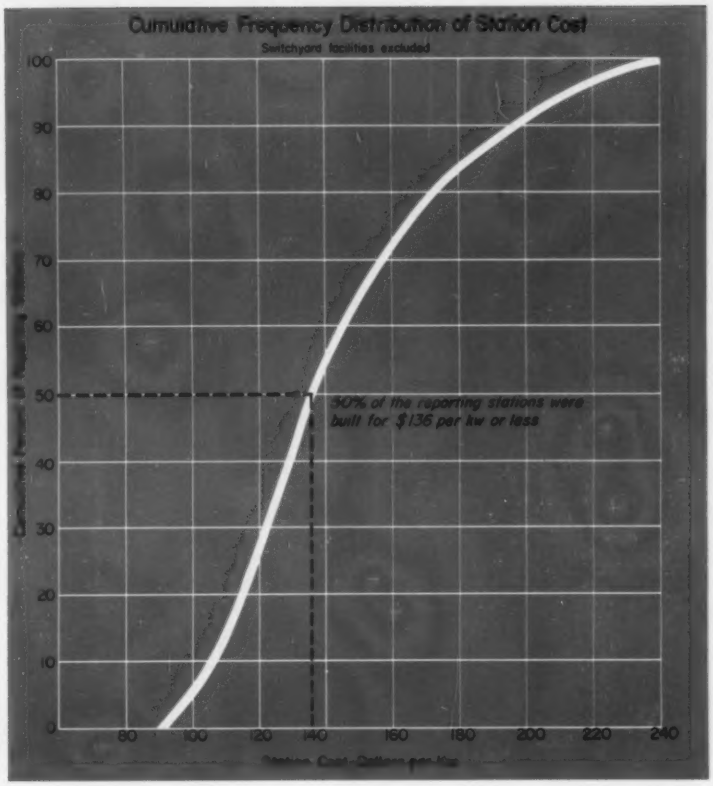
in the survey (44 in number) into nine groups does not necessarily put a representative number in each group.

Location Has Big Effect

Inspection of the bar chart below also shows the effect of location. With the exception of plants that have low energy costs because of unusual investment charges (e.g. depreciation only), most of the low-energy-cost plants have one thing in common—favorable locations, locations where outdoor type plants can be used or type of fuel burned is relatively cheap.

Fixed charges are about equal to operating costs when an average of these figures is taken for all reporting plants (excluding a few with unusually low fixed charges). But a closer look indicates a wider range of the ratio between these two types of charges. Only 50% of the plants showed a ratio of operating to fixed charges between 0.8 and 1.2.





Building Costs Are Up

• Average is reported at $146 per kw. Outdoor stations burning gas offer the lowest construction costs

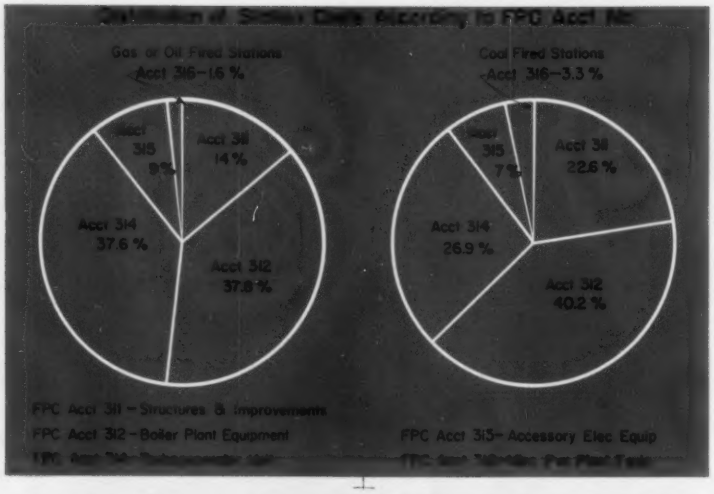
The cost of building a power plant has increased since EW's last survey. Results of this survey show that 50% of the stations cost $136 per kw or less (switchyard facilities excluded) to build. In the last survey this figure was $129. A comparison of these figures indicates an increase of about 5½% in station costs. The curve on the following page shows that this cost increase has occurred in all station sizes with the greatest increase in smaller stations.

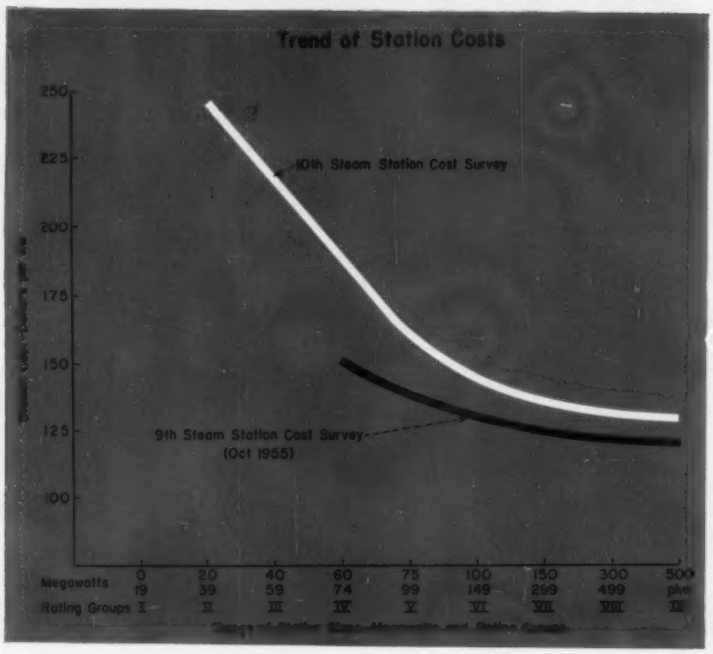
The average station cost was $146 per kw. In 1954 the comparative figure was $131, in 1952 between $130 and $135, and in 1950 between $145 and $150.

Outdoor plants were on the average cheaper to build than indoor plants. And plants built to burn gas or oil were cheaper than those built to burn coal primarily. Average cost of an outdoor plant was $127 per kw vs $157 for indoor plants; for gas or oil-fired plants the average was $120 vs $165 for coal-burning plants. As expected, the outdoor type plant burning gas offered the lowest construction cost.

This differential in cost when considering fuel burned or type of construction does not remain consistent when analyzed according to station size. Strangely, indoor construction on the average offered more economy in smaller plants. But for stations with a capacity of 100 Mw or greater outdoor construction was less expensive.

In all rating groups gas or oil-fired plants were cheaper to construct than coal-burning plants. But the differential in cost did not steadily decrease with an increase in size, as might be expected. In the 60- to





74-Mw range the differential is $55 per kw, in the 74 to 99-Mw range it is $95, in the 100 to 149-Mw range $65. In the 150 to 299-Mw range the differential dropped to $20, $30 in the 300 to 499-Mw range, and only $10 in the 500-Mw plus range.

As indicated previously, caution must be exercised when these figures and the accompanying curves are used. They represent trends of averages only and will not necessarily give exact figures for each size.

Distribution of station costs is about the same as in the previous survey. Boiler plant equipment takes the biggest bite out of the construction dollar—37.8 to 40.2% depending upon the type of fuel burned. This is practically the same as it was in 1955. Coal-fired plants with the need for pulverizers and fuel and ash-handling equipment logically showed the largest expenditure for steam generating facilities.

Structures and improvements did not get as large a share of the money as previously. Expenditures in this category were down about 13%. In the case of gas or oil-fired plants this decrease was offset by an increase in electric and miscellaneous power-plant-equipment expenditures.

Production

• Big stations with high plant factors have lowest unit costs. Average cost was 3.25 mills per kwhr

Average production or operating costs are up about 5% above comparable 1954 figures. They averaged 3.25 mills per net kwhr. Fuel as usual accounted for most of this cost. This is the way the average production costs divided:

Fuel	83.0%
Labor	11.0
Maintenance	5.5
Water, lubrication, supplies	0.5
	100.0%

The extent to which a plant is used obviously has a great effect on overall production costs. For this reason, plant factor was taken into account when developing the trend of production costs as a function of station size. The curve at the right shows what should be expected, the larger the station and the more it is used the less will be the unit cost of

Station Heat

• Trend of heat rate curve same as in 1954 and 1956. Fuel costs also the same except for price of gas

The trend in station heat rates (see graph at right) was about the same as in the previous survey. Larger plants had a slightly better heat rate; smaller plants a slightly poorer one.

But throughout the length of the trend line the 1954 and 1956 figures are about the same in all rating groups.

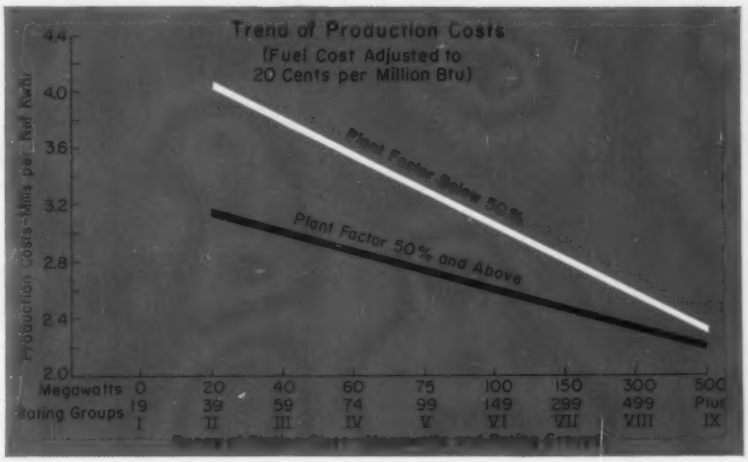
The improved heat rate in larger stations is probably attributable to the use of larger units, particularly in the 500-Mw plus station range. The range from high to low showed an improvement of 46%.

Costs Inch Up; Fuel Major Outlay

production. Fuel costs were adjusted to a common base for these curves so as to remove the effect of favorable location (e.g. low-cost fuel area) from the trend curves.

Plant factor showed less of an effect on labor costs. Unit labor cost seemed to be more directly affected by station size only. For while average unit labor costs were 0.35 mills per net kwhr, costs for small plants (100 Mw and below) were almost double—0.63 mills. Labor costs for large plants, 300 Mw and above, averaged about 0.2 mills per net kwhr.

The boiler continued to claim the largest chunk of the maintenance dollar. Expenditures for this type of maintenance averaged about 0.063 mills per net kwhr. Similar expenses for the prime mover and its auxiliaries was 0.047 mills, and 0.0434 mills for the fuel-handling equipment. But maintenance expenditures for boilers are not as high as they were in the last survey. At that time they averaged 0.071 mills and were about 40% greater than maintenance expenses for the prime mover and its auxiliaries. In this survey boiler-maintenance expenses were 33% greater than prime mover maintenance expenses.



A closer look at the boiler-maintenance account reveals that less maintenance was involved with gas or oil-fired steam generators than with coal-fired (0.06 mills vs 0.078 mills per kwhr). As should be expected, older boilers require more maintenance—but only about 15% more in terms of dollars spent. This is based on a comparison of boilers placed in operation before 1955 and those that were first operated in 1955 or 1956.

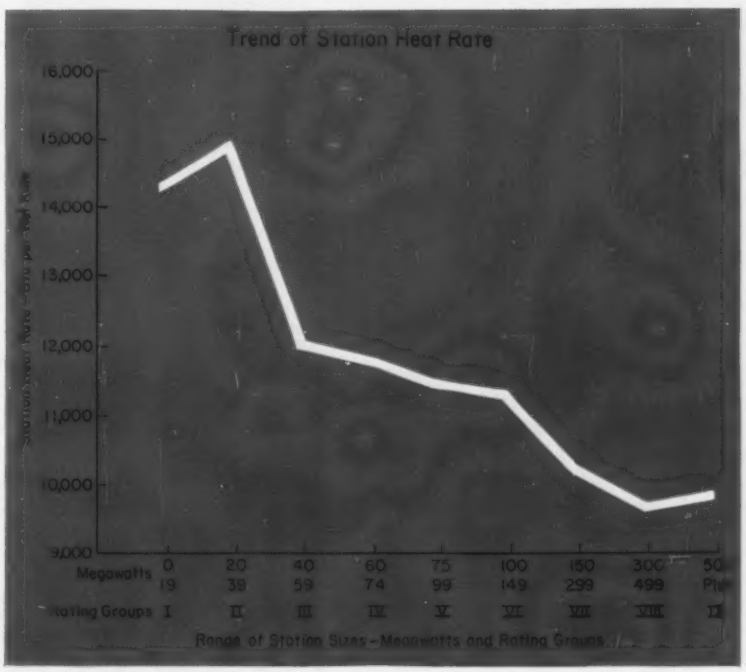
Outdoor boilers on the average required more maintenance than those indoors. In this survey maintenance expenses for outdoor boilers averaged 0.079 mills per kwhr, while similar expenditures for the indoor installations was 0.069 mills.

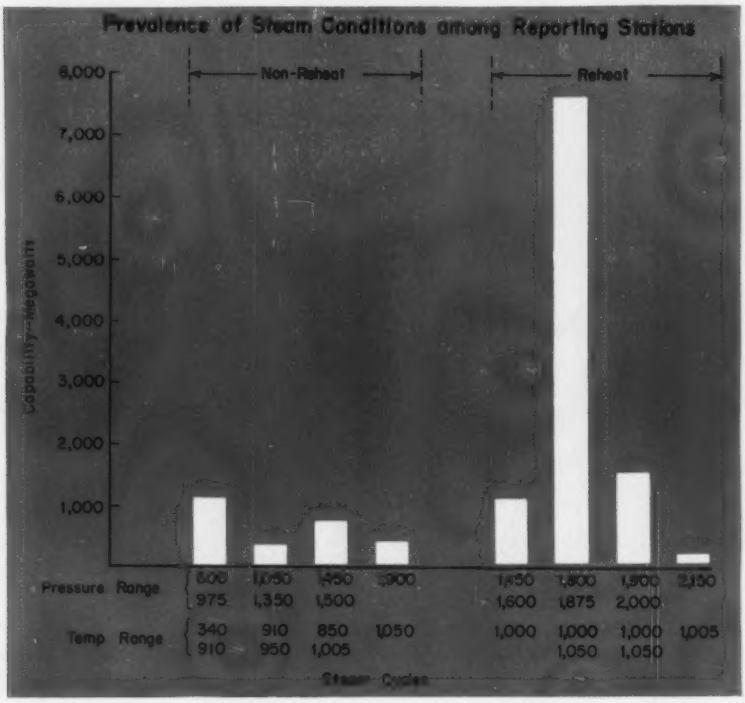
Rates Hold

Station plant factor averaged 69%, about the same as it was in 1954. Most plants operating with a plant factor greater than the average were in the large-station category (150-Mw or larger). But despite this, there was no definite relationship between plant size and plant factor. Such a relationship should not necessarily be expected because plant factor depends on size and station efficiency as related to a particular system, not merely on size.

New Units Worked Hard

Utilities continue to work their new modern plants as hard as they can. Utilization factor was again over 100%; it averaged 103% for stations of all sizes. This is slightly below the last survey's average of 106.4%, but still high when it is





realized that utilization factors were reported on a capacity basis rather than nameplate. Eight of the reported stations had utilization factors of 110% or greater.

Fuel costs have remained about the same in the past two years except for utilities depending primarily on gas. The price of this fuel jumped from an average of 16.6¢ per million Btu to 21.3¢ per million Btu.

New England continued to be the highest fuel-cost area. Fuel costs in this region averaged 37.24¢ per million Btu. Lowest fuel cost in the country was in the West South Central States. In latter region the cost averaged 13.72¢ per million Btu. In the rest of the country average costs were between 20 and 30¢ per million Btu.

Reheat Cycle Predominates

Perhaps the most outstanding statistic unearthed in this survey is the predominance of reheat steam cycles. Eighty percent of the capacity reported uses reheat, compared with 55% for the last survey. Stations using reheat cycles with steam conditions of 1,800 to 1,875 psi with 1,000 to 1,050F superheat accounted for 75% of the reheat installations. On a station basis 28 of the 44 reporting stations had one or more reheat units.

Seventy percent of the stations operated at a pressure of 1,200 psi or greater. In 1954 the figure was 85%, in 1952 it was 80%, and in 1950 about 33%. This does not indicate a retrogression as far as steam conditions are concerned, however, because it can be traced to the larger-than-normal number of small-unit stations reported in this new survey.

Station Designs Show Few Changes

• Number of plants using outdoor equipment shows little variation. Non-motor-driven boiler feed pumps used

Outdoor equipment was used in many stations listed in this survey. Fifty-eight percent had outdoor boilers, the same number had outdoor fans, 20% had outdoor turbine generators, and 17% outdoor condensers. These figures are probably slightly higher than those reported in our last survey. But the change to outdoor equipment is not progressing in leaps and bounds as it did in the postwar period. So it is no longer proper to speak of a trend toward outdoor design.

Most plants used shaft-driven exciters although the number reporting motor-driven ones is increasing. One of the newest design features disclosed in the survey was use of non-motor-driven boiler feed pumps, reported for five plants. A composite of plant design features is shown on the last page of the survey.

Coal Storage About the Same

Coal storage amounted to about 1 ton per kw. This is the same amount utilities reported in the 1955 survey (1954 figures). Most stations reported figures that were pretty close to the average. But one station in the 20-to-39Mw range reported keeping 4 tons of coal per kw on hand for emergencies. Average figures for coal storage and other plant space factors are tabulated on the last page.

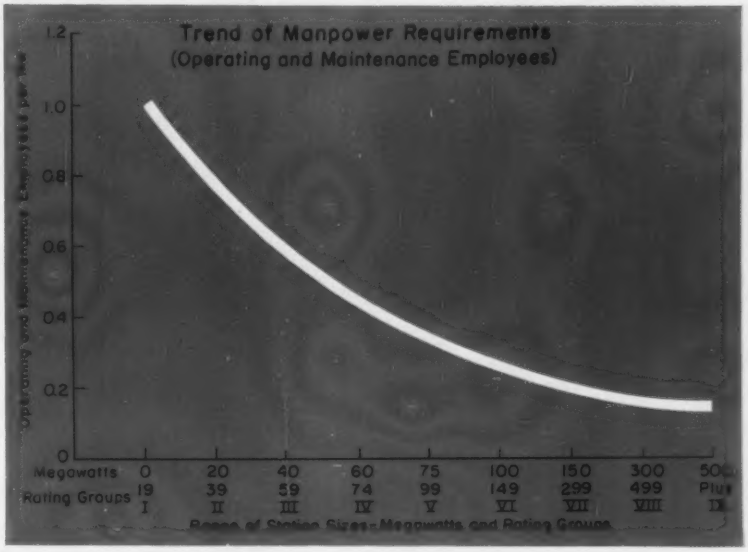
Boiler room volume requirements (indoor plants only) showed a definite relationship to plant size. They varied from a high of 18.76 cu ft per kw for the smallest plants to 11.64 cu ft per kw for 500-Mw-plus plants. An average of about 10 cu ft per kw was used in the turbine room.

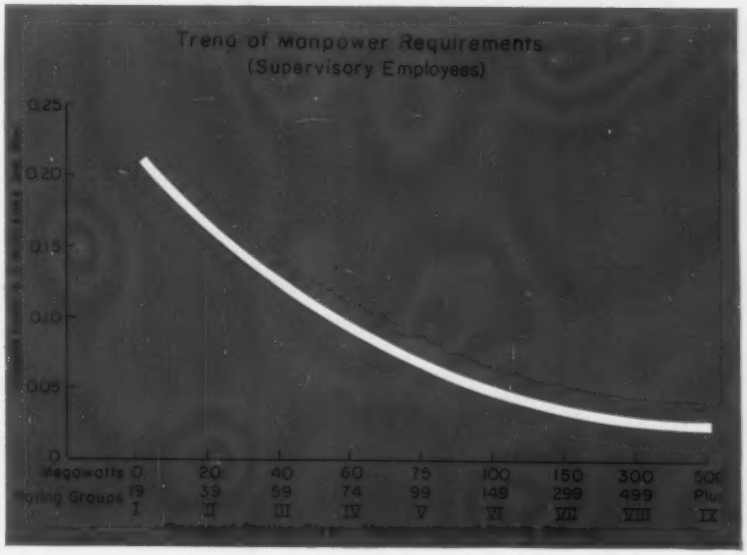
Big Plant Labor Needs Stay Fixed

• But labor requirements are up in small stations. Auxiliaries consume six percent of station output

Manpower requirements are up in small stations, down in medium-size stations, and about the same in large stations. This observation is the result of comparing this survey's operating and maintenance manpower needs with those of the last survey. The concentration of more megawatts in fewer units in the large stations is, of course, one of the main reasons why there has been a continual decrease in station manpower requirements. But in very large stations manpower requirements have remained fairly stable for recent surveys. Undoubtedly the industry is reaching the point of diminishing returns in this area with its present methods of using station labor.

The trend curve at the right also indicates that about five times as many men are required for operation and maintenance per Mw in small stations as in large stations. And about 2½ times as many are required in medium-size plants as in large plants.





Supervision Depends on Size

The effect of size is also very apparent in supervisory manpower requirements. In fact size is even more effective here than in operating and maintenance manpower. On a megawatt basis, ten times as much supervisory help is required in a small station as in large station. In a medium-size plant about four times as much supervision is needed per Mw as in large stations.

From this it follows that less supervisory manpower is needed for operating and maintenance manpower in large stations. The group averages obtained in the survey show that one supervisor is needed for each 4.8 workmen in the first size grouping (O to 19 Mw). But for the 500-Mw-plus grouping the comparative figure is 9.4. There is a gradual increase in workers per supervisor in the intervening rating groups used in the survey.

About 6% of gross generating capacity was consumed by station auxiliaries. The amount of energy used in the station does not seem to depend on station size or, to any large extent, type or fuel burned.

Auxiliaries in the medium-size stations on the average used slightly less energy than in either the very large or the small stations. But the differences are so slight that a definite trend could not be established.

Almost all stations used somewhere between 6 and 7% of gross generation for auxiliary power. Two plants reported 8%.

As indicated, fuel did not have a definable influence on the amount of power consumed by station auxiliaries. But most of the stations that used less than 5% of gross generation for auxiliary power were gas-fired plants. Aside from this final observation, the results of this survey are the same as the previous one in this particular area.

Cost and Performance Data of 44 Modern Steam Stations

Station Number†	288	289(234)	290	291	292	293(238)	294	295	296	297	298
GENERAL DATA											
Year, first operation	1954	1953	1954	1950	1954	1953	1955	1954	1954	1955	1955
newest unit	1955	1956	1955	1955	1954	1954	1956	1956	1955	1955	1956
Total generator rating (MMRC)*	IX	IX	IX	IX	IX	IX	IX	IX	VIII	VIII	VIII
No. of turbogenerators	9	10	4	4	4	4	3	4	2	2	2
Range of unit ratings*	VII	VII	VII	VII	VII	VII	VII	VII–VI	VII	VII	VII
No. of boilers	9	10	4	6	4	4	3	4	2	2	2
Range of ratings (M lb/hr)	1,000&1,280	1,000	1,280	730&1,100	1,134	1,070	1,280	850&1,200	1,050&1,450	1,200	1,254
Steam pressure (psi)	1,825&1,846	1,825	1,825	1,900	1,850	1,850	1,846	1,500&1,850	1,875	1,900	1,800
Stm temp, initial supht (F)	1,003&1,053	1,003	1,053	1,050	1,000	1,000	1,053	1,000	1,000	1,050	1,000
reheat (F)	1,003&1,053	1,003	1,053	1,000	1,000	1,000	1,053	1,000	1,000	1,010	1,000
Cooling water range (F)	39–72	35–85	38–80	43–84	45–73	34–73	38–83	65–80	41–81	45–80	50–73
Corresponding vacuum (in. Hg)	.65–2.36	.58–2.45	.46–1.94	.72–2.30	.87–1.88	.70–1.65	.77–2.56	1.5–2.0	.9–2.2	.66–1.79	1.3–1.5
Plant site area (acres)	851	2,735	1,353	.....	285	437	2,113	125	.....	216	.....
In use (acres)	59	126	111	109	68	437	68	25	79	54	24
Fuel storage, coal (tons)	1,350,000	1,450,000	740,000	710,500	1,008,000	1,800,000	520,000	.....	225,000	1,000,000	.....
Oil (bbl)	.....	.....	.....	.....	.....	125,000	.....	1,056,500	47,500	.....	60,000
Employees, total	572	582	281	266	90	172	281	134	81	146	54
Supervision	4	3	3	5	12	13	3	18	18	5	12
Operation	192	205	98	102	36	64	81	83	26	83	19
Maintenance	150	143	76	84	32	35	75	20	9	26	16
Clerical, stores	25	25	14	6	10	10	14	11	4	3	3
Fuel handling	121	140	50	24	.....	25	67	.....	15	14	.....
Guards, laborers	10	10	10	45	.....	25	10	2	9	15	4
OUTPUT DATA											
Total gross gen (kwhr x 10^6)	12,140	11,322	6,125	4,530	2,387	4,511	4,521	2,130	2,667	2,225	1,876
Total net gen (kwhr x 10^6)	11,504	10,735	5,820	4,158	2,250	4,287	4,299	1,990	2,509	2,062	1,785
Maximum 1-hr peak (Mw)	1,634	1,529	868	640	640	668	648	428	390	322	350
Hours operation 1956	8,760	8,760	8,760	8,784	8,784	8,784	8,760	8,784	8,784	8,784	8,447
FUEL CONSUMPTION DATA											
Coal (tons)	4,585,965	4,570,345	2,398,770	1,642,461	.....	1,590,705	1,544,393	.....	884,513	984,643	.....
Btu/lb	12,040	11,490	11,420	10,134	.....	12,400	12,880	.....	13,550	10,017	.....
Ash (%), moisture (%)	13.9; 4.9	10.9; 9.5	10.8; 9.7	11.5; 16.1	.....	10.1; 6.33	10.4; 4.1	.....	7.43; 3.5	13.3; 15.4	.....
Cost (¢/million Btu)	20.03	16.95	18.70	28.33	.....	29.6	20.09	.....	33.19	27.5	.....
Oil (bbl)	.....	.....	.....	.....	419,188	4,247	.....	1,577,250	12,497	.....	2,595,000
Btu/gal	.....	.....	.....	.....	151,597	138,200	.....	151,827	148,595	.....	156,000
Cost (¢/million Btu)	.....	.....	.....	.....	26.41	76.8	.....	34.4	47.15	.....	29.5
Gas (M cu ft)	.....	.....	.....	9,026,282	18,905,604	.....	.....	10,480,263	.....	.....	.....
Btu/cu ft	.....	.....	.....	1,043	1,089	.....	.....	1,092	.....	.....	.....
Cost (¢/million Btu)	.....	.....	.....	22.58	27.54	.....	.....	25.12	.....	.....	.....

Station Number†	288	289(234)	290	291	292	293(238)	294	295	296	297	298
OPERATING COSTS											
(Mills per net kwhr)											
Wages (incl supervision)	0.121	0.155	0.120	0.25	0.180	0.223	0.152	0.31	0.14	0.29	.....
Water, lubrication, supplies	0.033	0.021	0.036	0.09	0.037	0.035	0.042	0.11	0.03	0.07	.....
Maintenance	0.170	0.220	0.173	0.33	0.094	0.205	0.115	0.29	0.31	0.18	.....
Total, oper & mtce (excl fuel)	0.324	0.396	0.329	0.67	0.311	0.463	0.309	0.71	0.48	0.54	0.435
Fuel	1.991	1.698	1.804	2.78	2.836	2.750	1.895	3.18	3.19	2.63	2.800
Total operation (incl fuel)	2.315	2.094	2.133	3.45	3.147	3.210	2.204	3.89	3.67	3.17	3.235
INVESTMENT DATA											
(Dollars per kw)											
**(310) Land	0.72	0.28	0.33	0.38	0.78	1.32	2.30	1.89	0.15	2.00	0.77
(311) Structure, improvements	21.01	29.28	22.12	53.22	10.62	40.75	23.45	19.62	30.57	45.68	7.50
(312) Boiler plant equipment	48.20	56.49	49.97	73.32	54.27	60.52	49.89	59.85	72.97	75.84	50.50
(314) Turbogenerator unit	33.68	38.83	35.14	37.90	36.83	34.57	35.67	51.57	37.28	39.56	49.60
(315) Accessory elec equipment	6.78	7.75	7.44	23.12	8.85	12.93	7.49	8.63	9.64	20.51	9.45
(316) Misc plant equipment	1.16	1.30	2.33	1.14	1.68	3.09	2.24	2.18	3.40	1.62	2.67
Total station	111.56	113.92	117.32	189.08	113.03	153.19	121.04	143.74	154.01	185.21	120.40
Outdoor switchyard	5.43	5.63	6.18	10.63	12.13	6.04	8.87	6.15	9.51	15.09	6.62
Total, station and switchyard	116.99	139.55	123.50	199.71	125.16	159.23	129.91	149.89	163.52	200.30	127.02
COST OF ENERGY											
(Mills per net kwhr)											
Fixed charges	0.432	0.485	0.452	4.49	3.978	2.816	0.451	0.96	.....	4.65	3.05
Computed at (%)	2.822	2.761	2.843	14.14	12.67	12.61	2.815	7.439	.....	14.51	13.7
Operating charges	2.315	2.094	2.133	3.45	3.147	3.21	2.204	3.89	3.67	3.17	3.235
Total	2.747	2.579	2.585	7.94	7.125	6.026	2.655	4.85	.....	7.82	6.285
STATION PERFORMANCE 1956											
Billion Btu used	110,404	105,016	54,890	42,708	23,266	39,474	39,901	21,499	24,049	19,726	16,971
Fuel cost (¢/million Btu)	20.59	17.21	19.02	27.06	27.42	29.9	20.27	29.46	33.23	27.5	29.5
Btu/net kwhr send out	9,600	9,780	9,430	10,271	10,340	9,207	9,280	10,801	9,585	9,568	9,484
Btu/gross kwhr generated	9,090	9,280	8,960	9,608	9,767	8,751	8,830	10,095	9,019	8,865	9,020
Average boiler efficiency (%)	88.3	88.2	87.8	86.9	.....	89.3	89.2	.....	88.7	87.5	.....
Station thermal eff, net (%)	35.6	34.9	36.2	32.6	33.0	37.1	36.8	31.28	35.6	35.7	35.9
Employees per 1,000 kw	0.214	0.232	0.218	0.385	0.108	0.149	0.260	0.202	0.14	0.43	0.154
Plant factor, annual (%)	86.6	95.9	87.4	74.4	41.1	74.4	89.3	46.63	78.8	73.2	86.0
Utilization factor, annual (%)	102.1	101.9	108.4	99.4	102.4	100.0	108.0	82.31	101.3	100.0	100.0

Additional information (listed by station number):

288 Employee total includes 70 laboratory technicians
288, 289, 290, 294 Fixed charges represent depreciation only
289 Employee total includes 56 laboratory technicians
290 Employee total includes 30 laboratory technicians
291 Capability at 2½ in. back pressure
294 Employee total includes 31 laboratory technicians
295 Percentage at which fixed charges were computed consists of 5.0% sinking fund basis and 2.439% bond interest

† Numbers continue from previous surveys. Parentheses enclose old numbers of plants since modified.

* Rating groups (Manufacturer's Maximum Rated Capability) Mw; I, 0–19; II, 20–39; III, 40–59; IV, 60–74; V, 75–99; VI, 100–149; VII, 150–299; VIII, 300–499; IX, 500 up.

** Electric plant account numbers prescribed by Federal Power Commission

Cost and Performance Data of 44 Modern Steam Stations

Station Number†	299	300	301	302(253)	303(218)	304	305	306	307	308	309
GENERAL DATA											
Year, first operation	1955	1954	1954	1952	1952	1956	1953	1952	1954	1954	1952
newest unit	1956	1955	1954	1954	1955	1956	1955	1956	1955	1956	1954
Total generator rating (MMRC)*	VIII	VIII	VII	VII	VII	VII	VII	VII	VII	VII	VII
No. of turbogenerators	2	3	2	3	3	1	3	3	2	1	2
Range of unit ratings*	VII	VI	VI	VI–IV	VI–IV	VII	VI–V	III–VI	VI	VI	V
No. of boilers	2	3	2	3	3	1	3	3	2	1	3
Range of ratings (M lb/hr)	1,170	725	894	925&700	600–820	1,720	510&700	425–800	950	700	1,400
Steam pressure (psi)	1,850	1,875	2,080	1,450&850	900&1,450	2,050	1,475&1,825	1,500&2,150	1,550	1,550	1,050
Stm temp, initial supht (F)	1,000	1,000	1,050	1,000&900	950&1,000	1,050	1,010	955&1,005	1,000	1,000	910
reheat (F)	1,000	1,000	1,000	1,000	1,000	1,000	1,010	1,005	.....	1,000	.....
Cooling water range (F)	50–61	41–78	36–68	33–88	34–81	34–77	50–74	43–96	56–92	54–69	70–93
Corresponding vacuum (in. Hg)	.8–1.63	.8–2.0	.97–1.46	1.3–2.67	.83–2.1	.65–1.85	1.13–1.7	1.09–3.18	.7–2.65	.69–1.76	2.53–4.2
Plant site area (acres)	110	324	148	47	800	121	321	250	1,000	700	86
In use (acres)	74	324	.....	47	70	121	190	180	60	120	86
Fuel storage, coal (tons)	.....	500,000	90,000	260,000	600,000	1,800,000	100,000	.....	.....	.....	.....
Oil (bbl)	668,000	1,714	595	286	380	.....	1,070	231,000	55,000	263,000	100,000
Employees, total	76	104	77	75	74	126	82	53	42	71	41
Supervision	11	16	7	10	9	14	11	4	4	7	5
Operation	24	36	33	25	38	55	41	28	23	23	18
Maintenance	36	16	26	27	12	30	16	17	11	31	10
Clerical, stores	5	1	2	5	4	10	4	4	2	5	1
Fuel handling	.....	10	5	6	11	13	6	.....	.....	.....	.....
Guards, laborers	.....	25	4	2	.....	4	4	.....	2	5	7
OUTPUT DATA											
Total gross gen (kwhr x 10^6)	1,464	1,758	2,200	2,160	1,846	1,524	1,956	1,292	1,508	964	1,195
Total net gen (kwhr x 10^6)	1,379	1,660	2,090	2,053	1,747	1,443	1,870	1,212	1,416	921	1,135
Maximum 1-hr peak (Mw)	340	332	282	296	303	272	277	243	204	229	165
Hours operation 1956	8,784	8,784	8,784	8,776	8,784	6,329	8,760	8,784	8,784	8,200	8,784
FUEL CONSUMPTION DATA											
Coal (tons)	.....	688,525	755,281	1,044,274	612,390	498,394	286,773	.....	.....	.....	.....
Btu/lb	.....	12,000	12,768	10,777	11,050	12,230	13,256	.....	.....	.....	.....
Ash (%), moisture (%)	.....	8.77; 9.16	10.8;	19.5; 6.0	10.4; 12.8	10.8; 6.2	7.0; 4.0	.....	.....	.....	.....
Cost (¢/million Btu)	.....	28.18	17.83	12.14	27.02	29.2	33.58	.....	.....	.....	.....
Oil (bbl)	2,127,002	3,664	5,155	2,000	6,323	.....	850	18,086	.....	728,761	679
Btu/gal	153,360	136,000	138,800	138,450	134,200	.....	137,321	150,915	.....	152,643	152,660
Cost (¢/million Btu)	30.39	84.59	84.65	93.5	78.9	.....	83.34	21.7	.....	29.2	26.3
Gas (M cu ft)	.....	.....	.....	.....	4,789,672	10,788,000	10,976,243	12,308,021	13,841,183	4,406,939	12,726,950
Btu/cu ft	.....	.....	.....	.....	1,001	94	1,012	1,044	1,064	1,083	1,028
Cost (¢/million Btu)	.....	.....	.....	.....	24.39	27.5	27.0	17.69	24.9	21.9	10.81

Station Number†	299	300	301	302(253)	303(218)	304	305	306	307	308	309
OPERATING COSTS											
(Mills per net kwhr)											
Wages (incl supervision)	0.210	0.26	0.12	0.118	0.25	0.382	0.178	0.14	0.106	0.313	0.103
Water, lubrication, supplies	0.049	0.04	0.03	0.025	0.03	0.153	0.004	0.06	0.049	0.038	0.116
Maintenance	0.062	0.01	0.19	0.241	0.15	0.208	0.066	0.08	0.105	0.295	0.222
Total, oper & mtce (excl fuel)	0.321	0.31	0.34	0.382	0.43	0.744	0.248	0.28	0.260	0.646	0.441
Fuel	3.018	2.82	1.66	1.363	2.78	2.73	2.971	1.89	2.563	2.612	1.255
Total operation (incl fuel)	3.339	3.13	2.00	1.745	3.21	3.47	3.219	2.17	2.823	3.258	1.696
INVESTMENT DATA											
(Dollars per kw)											
**(310) Land	0.52	0.235	0.34	0.29	0.43	4.93	0.49	0.02	0.298	15.01	0.52
(311) Structure, improvements	17.00	20.931	26.05	18.72	35.27	40.02	33.56	20.33	6.181	35.09	0.61
(312) Boiler plant equipment	57.73	60.639	53.37	56.59	60.62	52.82	64.72	45.33	46.369	45.06	36.53
(314) Turbogenerator unit	44.68	42.390	42.15	41.74	39.24	38.07	42.02	41.23	46.664	40.85	39.05
(315) Accessory elec equipment	8.50	7.634	10.45	8.66	7.51	9.75	12.88	10.11	9.538	11.66	5.82
(316) Misc plant equipment	2.39	1.369	2.60	1.36	1.53	1.97	2.00	0.79	1.050	3.02	1.24
Total station	130.82	131.196	134.96	127.36	144.60	147.60	155.67	117.99	111.100	150.69	93.77
Outdoor switchyard	14.26	5.379	15.85	6.09	10.97	5.42	9.89	7.35	7.739	8.72	7.90
Total, station and switchyard	145.08	138.575	150.81	133.45	155.57	153.02	165.56	125.34	118.839	159.41	101.67
COST OF ENERGY											
(Mills per net kwhr)											
Fixed charges	3.754	2.72	.....	.....	2.93	3.353	3.319	2.61	2.702	4.123	1.882
Computed at (%)	12.67	13.75	.....	.....	13.6	12.61	15.0	12.0	15.7	15.0	15.0
Operating charges	3.339	3.13	2.00	1.745	3.21	3.47	3.219	2.17	2.823	3.258	1.696
Total	7.093	6.85	.....	.....	6.14	6.823	6.538	4.78	5.525	7.381	3.578
STATION PERFORMANCE 1956											
Billion Btu used	13,700	16,562	19,316	21,500	18,362	13,190	18,715	12,963	15,105	9,442	13,095
Fuel cost (¢/million Btu)	30.39	28.25	17.94	11.85	26.44	29.6	29.69	17.68	24.9	25.5	10.89
Btu/net kwhr send out	9,931	9,973	9,241	10,960	10,508	9,139	10,064	10,694	10,426	10,243	11,530
Btu/gross kwhr generated	9,358	9,420	8,778	10,420	9,945	8,651	9,567	10,035	10,010	9,785	10,950
Average boiler efficiency (%)	.....	87.3	91.2	86.1	87.34	88.3	.....	.....	86.9	84.37	88.6
Station thermal eff, net (%)	34.4	34.23	36.9	31.1	32.48	37.22	33.98	31.9	29.47	33.32	29.63
Employees per 1,000 kw	0.192	0.347	0.21	0.197	0.36	0.321	0.336	0.25	0.21	0.27	0.256
Plant factor, annual (%)	50.5	58.35	90.8	96.7	80.85	87.7	89.4	70.0	79.0	70.48	80.7
Utilization factor, annual (%)	108.8	100.6	102.2	101.26	116.38	100.0	110.1	115.7	102.0	114.50	103.6

Additional information (listed by station number):

303 Fixed charges (mills per net kwhr) do not include outdoor switchyard cost.

308 Two-unit plant, unit no. 1 operated 8,200 hr in 1956 and unit no. 2 operated 4,033 hr.

† Numbers continue from previous surveys. Parentheses enclose old numbers of plants since modified.

* Rating groups (Manufacturer's Maximum Rated Capability) Mw; I, 0–19; II, 20–39; III, 40–59; IV, 60–74; V, 75–99; VI, 100–149; VII, 150–299; VIII, 300–499; IX, 500 up.

** Electric plant account numbers prescribed by Federal Power Commission

Cost and Performance Data of 44 Modern Steam Stations

Station Number†	310	311	312	313	314	315(281)	316	317	318	319	320
GENERAL DATA											
Year, first operation	1953	1910	1955	1955	1955	1954	1949	1949	1949	1954	1952
newest unit	1954	1954	1955	1955	1955	1956	1954	1955	1956	1954	1955
Total generator rating (MMRC)*	VII	VI	VI	VI	VI	VI	VI	VI	VI	VI	V
No. of turbogenerators	2	7	1	1	1	2	4	3	3	1	2
Range of unit ratings*	V	I–III	VI	VI	VI	IV	I–III	II–IV	II	VI	II–IV
No. of boilers	2	22	1	1	1	2	4	3	3	1	2
Range of ratings (M lb/hr)	525	15–450	1,150	950	900	630	150–450	200–500	150–300	950	300&630
Steam pressure (psi)	1,500	200–850	1,550	2,000	1,800	850	600–850	975&2,050	870	1,550	850
Stm temp, initial supht (F)	1,005	525–900	1,005	1,050	1,000	900	825–900	900&1,050	900	1,005	910
reheat (F)	1,005	.....	1,005	1,000	1,000	.....	.....	1,000	.....	.....	.....
Cooling water range (F)	32–90	38–95	65–98	33–80.5	34–71	70–91	40–85	32–82	60–93	42–90	58–117
Corresponding vacuum (in. Hg)	.9–1.88	1–2.5	1.66–2.56	.54–1.7	.58–1.2	.78–3.08	1.0–1.6	.5–2.0	1.2–3.0	.71–2.3	.68–4.5
Plant site area (acres)	207	100	346	285	138	102	12	.....	.....	1,585	42
In use (acres)	70	40	.....	133	27	52	12	.....	10	.....	14
Fuel storage, coal (tons)	100,000	50,000	.....	195,000	200,000	.....	.....	5,000	.....	.....	.....
Oil (bbl)	.....	100,000	20,000	27	.....	20,000	21,000	262,000	20,446	12,500	20,000
Employees, total	69	90	33	44	56	30	40	68	49	32	32
Supervision	15	5	3	6	9	1	1	4	2	2	2
Operation	27	52	18	14	24	18	27	35	35	18	18
Maintenance	15	28	9	8	11	6	8	16	8	7	6
Clerical, stores	4	5	2	2	4	1	2	2	1	2	2
Fuel handling	5	.....	.....	7	5	.....	2	7	.....	.....	.....
Guards, laborers	3	.....	1	7	3	4	.....	4	3	3	4
OUTPUT DATA											
Total gross gen (kwhr x 10^6)	1,042	678	974	1,052	1,089	379	457	543	266	615	493
Total net gen (kwhr x 10^6)	991	644	920	992	1,028	350	428	505	248	583	472
Maximum 1-hr peak (Mw)	164	128	158	143	155	157	90	115	60	114	115
Hours operation 1956	8,784	8,784	7,901	8,563	8,490	8,765	8,784	8,784	8,784	8,102	8,784
FUEL CONSUMPTION DATA											
Coal (tons)	414,921	23,046	.....	392,048	376,556	.....	.....	174,805	.....	.....	.....
Btu/lb	11,655	12,000	.....	11,727	12,990	.....	.....	12,902	.....	.....	.....
Ash (%), moisture (%)	9.5; 10.3	10; 10.65	.....	8.2; 6.0	9.35; 4.41	.....	.....	9.6; 5.43	.....	.....	.....
Cost (¢/million Btu)	22.6	22.4	.....	28.14	32.74	.....	.....	35.04	.....	.....	.....
Oil (bbl)	.....	7,232	94	2,000	.....	47	1,198	7,960	515,417	52	9
Btu/gal	.....	152,000	147,831	136,930	.....	140,000	154,000	136,574	154,167	150,060	140,000
cost (¢/million Btu)	.....	33.0	53.7	64.29	.....	45.5	52.9	79.89	42.72	49.91	45.5
Gas (M cu ft)	.....	7,770,351	8,586,920	.....	.....	4,028,524	4,830,136	820,905	.....	5,966,171	5,629,736
Btu/cu ft	.....	1,035	1,124	.....	.....	1,055	1,100	1,065	.....	1,065	1,046
Cost (¢/million Btu)	.....	18.91	14.02	.....	.....	16.8	24.9	29.52	.....	13.93	12.2

Station Number†	310	311	312	313	314	315(281)	316	317	318	319	320
OPERATING COSTS											
(Mills per net kwhr)											
Wages (incl supervision)	0.293	0.47	0.12	0.38	0.22	0.313	0.34	0.408	0.699	0.23	0.228
Water, lubrication, supplies	0.025	0.05	0.04	.....	0.06	0.138	0.06	0.055	0.099	0.03	0.035
Maintenance	0.044	0.19	0.11	0.20	0.12	0.216	0.16	0.320	0.257	0.08	0.124
Total, oper & mtce (excl fuel)	0.362	0.71	0.27	0.58	0.40	0.667	0.56	0.783	1.055	0.34	0.388
Fuel	2.207	2.59	1.45	2.62	3.12	2.04	3.09	3.710	5.728	1.49	1.52
Total operation (incl fuel)	2.569	3.30	1.72	3.20	3.52	2.710	3.65	4.493	6.783	1.83	1.910
INVESTMENT DATA											
(Dollars per kw)											
**(310) Land	.....	0.19	0.51	6.93	0.59	0.604	0.21	4.52	0.78	1.48	0.41
(311) Structure, improvements	24.14	16.85	18.50	48.00	35.62	11.56	9.22	45.10	21.88	23.89	15.0
(312) Boiler plant equipment	54.16	48.75	40.00	83.70	62.32	30.60	.....	92.91	40.69	40.62	32.5
(314) Turbogenerator unit	41.40	36.00	32.00	45.20	38.92	45.30	.....	48.29	30.46	32.52	40.4
(315) Accessory elec equipment	11.34	9.14	7.82	13.79	12.34	8.90	.....	16.06	9.27	10.87	11.7
(316) Misc plant equipment	0.25	2.37	0.65	1.98	3.02	1.89	.....	2.41	1.12	1.24	1.69
Total station	131.29	113.30	99.10	199.60	152.81	98.90	109.35	209.29	104.20	109.00	101.80
Outdoor switchyard	6.74	15.41	5.32	11.74	11.39	16.40	5.98	12.06	2.11	6.98	23.20
Total, station and switchyard	138.03	128.71	104.42	211.34	164.20	115.30	115.33	221.35	106.31	116.00	125.00
COST OF ENERGY											
(Mills per net kwhr)											
Fixed charges	.....	1.53	.....	4.49	2.81	5.43	.....	6.923	1.742	.....	3.29
Computed at (%)	.....	5.92	.....	15.0	14.0	12.5	.....	14.37	.....	.....	12.5
Operating charges	2.569	3.30	1.72	3.20	3.52	2.71	3.65	4.493	6.783	1.83	1.91
Total	.....	4.83	.....	7.69	6.33	8.14	.....	11.416	8.525	.....	5.20
STATION PERFORMANCE 1956											
Billion Btu used	9,672	8,637	9,649	9,210	9,781	4,250	5,313	5,431	3,337	6,355	5,894
Fuel cost (¢/million Btu)	22.60	19.2	14.02	28.23	32.9	16.8	24.9	34.53	42.72	13.93	12.2
Btu/net kwhr send out	9,766	13,395	10,489	9,282	9,504	12,153	12,413	10,747	13,404	10,903	12,472
Btu/gross kwhr generated	9,287	12,730	9,905	8,750	8,984	11,180	11,625	9,989	12,523	10,332	11,940
Average boiler efficiency (%)	.....	82.87	85.9	89.92	89.0	84.7	88.08	.....	86.5	88.8	84.9
Station thermal eff, net (%)	34.95	25.48	32.5	36.77	35.91	28.1	27.49	31.76	25.5	31.3	27.4
Employees per 1,000 kw	0.46	0.553	0.22	0.312	0.26	0.182	0.31	0.464	0.40	0.29	0.242
Plant factor, annual (%)	72.33	50.1	80.3	85.44	95.0	27.6	46.45	56.3	28.6	71.9	48.8
Utilization factor, annual (%)	109.3	84.4	109.0	101.7	114.8	104.5	80.35	105.2	57.3	114.0	102.0

Additional information (listed by station number):

316 Investment for boiler, turbine generator, electrical equipment and misc plant equipment totaled $99.92 per kw

† Numbers continue from previous surveys. Parentheses enclose old numbers of plants since modified.

* Rating groups (Manufacturer's Maximum Rated Capability) Mw; I, 0–19; II, 20–39; III, 40–59; IV, 60–74; V, 75–99; VI, 100–149; VII, 150–299; VIII, 300–499; IX, 500 up.

** Electric plant account numbers prescribed by Federal Power Commission

Cost and Performance Data of 44 Modern Steam Stations

Station Number†	321	322	323	324	325	326	327	328	329	330	331
GENERAL DATA											
Year, first operation	1955	1953	1952	1957	1954	1955	1954	1951	1955	1954	1951
newest unit	1955	1953	1954	.....	1954	1955	1954	1955	1954	1954	1951
Total generator rating (MMRC)*	V	V	V	V	IV	IV	IV	IV	III	II	I
No. of turbogenerators	1	1	3	1	1	2	1	2	1	1	1
Range of unit ratings*	V	V	II	V	IV	IV	IV	II	III	II	I
No. of boilers	1	1	3	1	1	2	1	2	1	1	1
Range of ratings (M lb/hr)	525	525	200&305	625	600	300	600	300	400	250	100
Steam pressure (psi)	1,500	1,500	860	1,350	1,250	875	950	850	875	925	600
Stm temp, initial supht (F)	1,000	1,000	900	950	950	910	900	910	910	905	339
reheat (F)	1,000	1,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cooling water range (F)	69–83	37–83	73–78	50–90	32–78	55–92	34–72	70–90	.....	37–79	68–78
Corresponding vacuum (in. Hg)	1.5–1.63	.21–1.52	6.2–6.4	1–3.25	1–2.24	.6–2.5	.5–1.31	.78–3.0	.....	.93–1.19	.9–1.3
Plant site area (acres)	1,616	430	.....	160	38	140	120	31	.....	120	3.4
In use (acres)	322	92	22	103	38	60	18	22	.....	15	2.5
Fuel storage, coal (tons)	150,000	81,682	.....	.....	200,000	100,000	400,000	.....	80,000	100,000	.....
Oil (bbl)	4,782	4,763	45,000	.....	55,000	.....	475	45,000	.....	.....	3,048
Employees, total	81	79	41	24	52	30	34	31	43	28	12
Supervision	10	10	4	2	10	2	6	1	7	3	2
Operation	24	23	31	14	20	14	18	18	21	16	10
Maintenance	18	18	3	5	10	6	4	6	2	3	.....
Clerical, stores	7	6	1	1	3	1	1	2	2	1	.....
Fuel handling	12	13	.....	.....	5	4	3	2	4	3	.....
Guards, laborers	10	9	2	2	4	3	2	4	7	2	.....
OUTPUT DATA											
Total gross gen (kwhr x 10^6)	416	405	472	.....	512	453	289	246	240	77	40
Total net gen (kwhr x 10^6)	385	381	444	.....	486	429	276	230	229	68	37
Maximum 1-hr peak (Mw)	84	81	77	.....	73	66	67	80	49	28	8
Hours operation 1956	7,585	7,677	8,784	.....	8,685	8,784	6,850	8,335	7,768	7,951	8,657
FUEL CONSUMPTION DATA											
Coal (tons)	184,169	190,347	.....	.....	200,007	61,459	130,500	.....	39,335	73,528	.....
Btu/lb	10,942	10,447	.....	.....	13,228	9,600	12,437	.....	11,716	6,891	.....
Ash (%), moisture (%)	7.6;15.2	9.3;16.5	.....	.....	7.5;5.0	15;16	8.8;7.2	.....	11.2;9.6	7.1;35.6	.....
Cost (¢/million Btu)	21.84	23.60	.....	.....	37.25	28.71	35.94	.....	26.31	22.6	.....
Oil (bbl)	1,729	744	2,596	.....	2,679	.....	614	.....	.....	.....	1,200
Btu/gal	140,000	140,000	143,600	.....	153,700	.....	139,000	.....	.....	.....	150,000
cost (¢/million Btu)	80.0	75.0	19.89	.....	36.47	.....	89.5	.....	.....	.....	46.66
Gas (M cu ft)	.....	.....	5,266,256	.....	.....	4,047,686	.....	2,816,780	1,810,716	10,146	618,173
Btu/cu ft	.....	.....	1,072	1,000	.....	1,000	.....	1,010	1,019	1,040	860
Cost (¢/million Btu)	.....	.....	19.03	17.5	.....	26.2	.....	14.5	17.84	32.7	24.0

Station Number†	321	322	323	324	325	326	327	328	329	330	331
OPERATING COSTS											
(Mills per net kwhr)											
Wages (incl supervision)	0.66	0.68	0.41	.....	0.60	0.21	0.670	0.427	0.86	1.02	1.327
Water, lubrication, supplies	0.15	0.11	0.05	.....	0.06	0.08	0.014	0.095	0.23	0.25	0.153
Maintenance	0.30	0.41	0.14	.....	0.12	0.15	0.123	0.250	0.30	0.59	0.293
Total, oper & mtce (excl fuel)	1.11	1.20	0.60	.....	0.78	0.44	0.806	0.772	1.39	1.86	1.773
Fuel	2.34	2.47	2.43	.....	4.07	3.30	4.230	1.790	2.53	3.37	3.963
Total operation (incl fuel)	3.45	3.67	3.03	.....	4.85	3.74	5.040	2.560	3.92	5.23	5.736
INVESTMENT DATA											
(Dollars per kw)											
**(310) Land	7.44	3.79	0.46	1.16	1.41	0.24	0.22	0.234	3.0	0.67	1.34
(311) Structure, improvements	57.10	84.09	14.50	19.03	65.64	42.50	41.57	30.30	39.0	50.00	30.50
(312) Boiler plant equipment	75.69	76.57	38.20	38.44	77.59	28.50	62.87	36.70	72.0	98.84	62.19
(314) Turbogenerator unit	50.24	38.56	52.75	53.13	45.73	32.00	40.47	46.60	83.0	79.16	69.69
(315) Accessory elec equipment	18.14	15.61	23.30	8.67	16.59	17.00	7.85	10.50	25.0	16.52	9.11
(316) Misc plant equipment	5.53	5.52	1.73	1.46	5.55	54.50	3.25	2.65	3.0	1.52	2.14
Total station	214.14	224.16	130.94	121.89	212.52	174.74	156.23	127.00	215.0	246.71	174.97
Outdoor switchyard	20.08	14.53	4.92	4.80	8.01	9.15	10.21	20.70	.....	10.13	.....
Total, station and switchyard	234.22	238.69	135.86	126.69	220.53	183.89	166.44	147.70	.....	256.84	.....
COST OF ENERGY											
(Mills per net kwhr)											
Fixed charges	6.00	6.35	3.764	.....	4.1	3.94	6.10	5.29	.....	16.32	3.493
Computed at (%)	13.5	13.5	16.0	.....	13.0	14.0	16.08	12.5	.....	17.5	8.166
Operating charges	3.45	3.67	3.031	.....	4.9	3.74	5.04	2.56	3.92	5.23	5.736
Total	9.45	10.02	6.795	.....	9.0	7.68	11.14	7.85	.....	21.55	9.229
STATION PERFORMANCE 1956											
Billion Btu used	4,041	3,961	5,667	.....	5,309	5,290	3,250	2,845	2,766	1,023	546
Fuel cost (¢/million Btu)	21.99	23.74	19.01	.....	37.24	26.8	36.0	14.5	.....	22.7	.....
Btu/net kwhr send out	10,481	10,379	12,714	.....	10,920	12,308	11,744	12,345	12,055	14,900	14,300
Btu/gross kwhr generated	9,699	9,762	11,979	.....	10,360	11,685	11,211	11,500	11,515	13,100	13,182
Average boiler efficiency (%)	89.26	87.84	83.58	.....	88.9	86.0	87.21	81.8	84.7	76.4	84.86
Station thermal eff, net (%)	30.71	30.41	28.58	.....	32.2	27.7	29.05	27.6	29.6	23.0	23.87
Employees per 1,000 kw	0.50	0.506	0.442	.....	0.722	0.45	0.424	0.364	0.93	1.00	1.30
Plant factor, annual (%)	55.83	56.39	69.0	.....	81.8	78.0	62.4	35.1	67.0	39.0	61.95
Utilization factor, annual (%)	100.00	100.00	95.0	.....	101.0	100.0	103.2	105.0	106.0	114.0	123.0

Additional information (listed by station number):

† Numbers continue from previous surveys. Parentheses enclose old numbers of plants since modified.

* Rating groups (Manufacturer's Maximum Rated Capability) Mw; I, 0–19; II, 20–39; III, 40–59; IV, 60–74; V, 75–99; VI, 100–149; VII, 150–299; VIII, 300–499; IX, 500 up.

** Electric plant account numbers prescribed by Federal Power Commission

Power Plant Space Factors

BOILER ROOM (CU FT/KW)

Mw Range	Max	Min	Avr
0–19	....	....	18.76
20–39	....	....	.....
40–59	....	....	.....
60–74	26.00	2.90	16.54
75–99	14.97	1.15	7.51
100–149	13.20	1.82	14.23
150–299	18.00	9.92	13.60
300–499	18.99	4.76	13.06
500 & up	14.56	2.04	11.64

TURBINE ROOM (CU FT/KW)

Mw	Max	Min	Avr
0–19	.....	....	12.27
20–39	.....	....	.....
40–59	.....	....	10.00
60–74	16.00	7.40	11.52
75–99	5.83	2.63	4.78
100–149	12.25	4.10	7.38
150–200	16.70	5.10	9.01
300–499	9.60	5.75	7.44
500 & up	12.12	6.44	8.53

SWITCHHOUSE (CU FT/KW)

0–19	....	....	0.23
20–39	....	....	0.72
40–59	....	....	4.00
60–74	2.20	0.12	0.89
75–99	....	....	0.23
100–149	2.90	0.14	0.83
150–299	0.72	0.13	0.34
300–499	0.34	0.13	0.24
500 & up	0.67	0.03	0.27

OFFICE (CU FT/KW)

0–19	....	....	0.53
20–39	....	....	0.85
40–59	....	....	2.00
60–74	2.09	0.73	1.50
75–99	4.50	0.36	1.85
100–149	4.20	0.09	1.29
150–299	1.34	0.03	0.49
300–499	1.16	0.32	0.58
500 & up	3.07	0.30	1.08

BUILDING, GROUND AREA (SQ FT/KW)

0–19	....	....	27.98
20–39	....	....	0.41
40–59	....	....	12.00
60–74	0.58	0.30	0.43
75–99	0.59	0.17	0.33
100–149	11.90	0.15	2.29
150–299	0.52	0.11	0.29
300–499	0.31	0.17	0.23
500 & up	0.50	0.04	0.24

SWITCHYARD (SQ FT/KW)

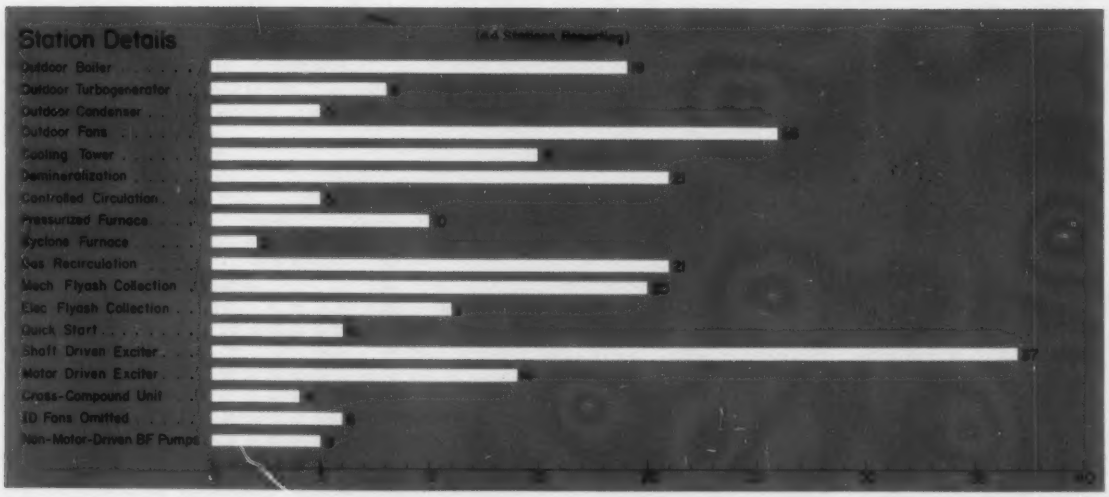
0–19	....	....	1.94
20–39	....	....	0.89
40–59	....	....	1.00
60–74	1.20	0.09	0.68
75–99	1.49	0.13	0.60
100–149	1.12	0.04	0.50
150–299	0.68	0.02	0.26
300–499	0.51	0.12	0.27
500 & up	0.72	0.10	0.28

FUEL STORAGE AREA (SQ FT/KW)

0–19	....	....	1.11
20–39	....	....	10.20
40–59	....	....	18.00
60–74	6.08	0.79	2.59
75–99	2.04	0.11	1.18
100–149	3.56	0.25	1.23
150–299	2.40	0.68	1.29
300–499	3.00	0.16	1.38
500 & up	2.02	1.00	1.54

COAL STORAGE (TONS/KW)

0–19	....	....	....
20–39	....	....	4.00
40–59	....	....	....
60–74	2.78	0.38	....
74–99	1.40	0.75	....
100–149	1.39	0.46	0.86
150–399	2.30	0.33	1.11
300–499	1.40	0.58	0.99
500 & up	2.71	0.61	1.16



How General Electric speeds turbine-generator production

Advanced machines and techniques improve General Electric's turbine-generator output

Expanded facilities will soon add to the production capacity of the large steam turbine-generator plant. Shown reviewing expansion plans are H. R. Hill, Mgr-Manufacturing, C. A. Lilly, Mgr-Marketing, and W. E. Saupe, Gen'l Mgr.

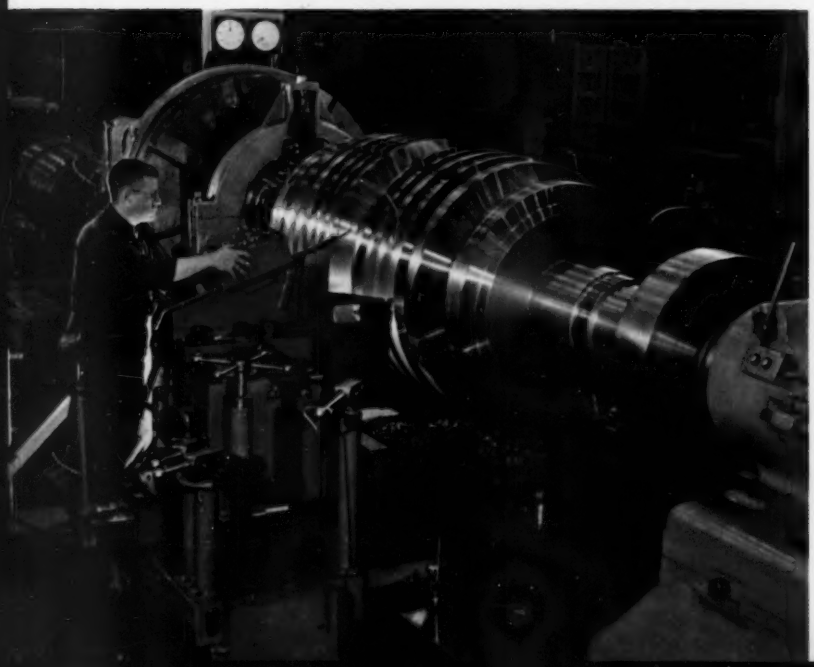
Meeting the requirements of the constantly expanding electric utility industry sets a challenge that is answered by General Electric's continued investment in its large steam turbine-generator manufacturing facilities in Schenectady.

New machine tools – some of them the largest ever made and the only ones of their type – add to the production efficiency required to build precision turbine-generator components, many with tolerances as close as those of a fine watch. Combined with General Electric's organization of skilled craftsmen and turbine-generator engineers, these tools and facilities provide the flexibility needed to keep pace with today's rapid advances in turbine-generator technology. And, in building tomorrow's even more efficient and reliable machines of advanced design, this combination will help maintain a well-established reputation for meeting delivery commitments.

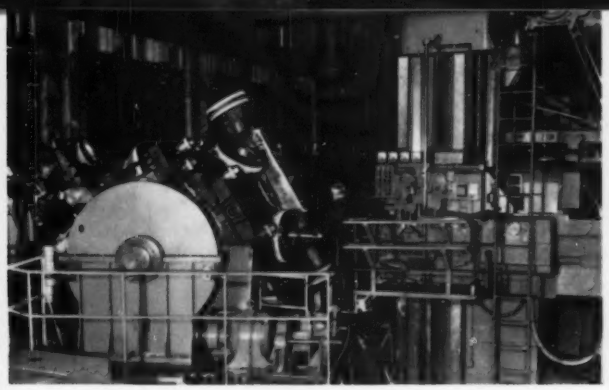
A few of the facilities in the large steam turbine-generator plant that contribute to these outstanding achievements are shown here.

GENERAL ELECTRIC

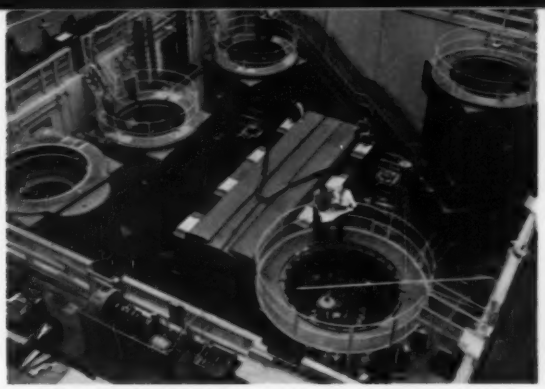
Grooving lathe removes metal from this turbine rotor at the rate of 100 cubic inches per minute – can take 25-ft forgings weighing up to 100 tons and is equipped to machine deep grooves up to 2½ inches wide.



Traveling reamer brings machine to job. Here, unit reams holes in turbine wheel and dovetails of 43-inch buckets.



Horizontal boring mill has special fixture for positioning and machining 100-ton turbine shells at complex angles. This unique arrangement considerably reduces set-up time.



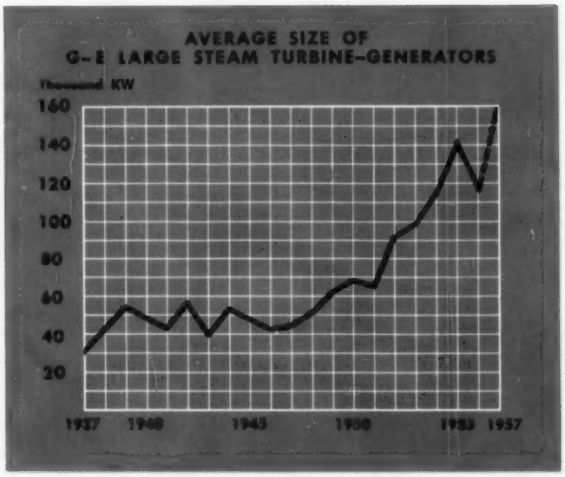
30-ft deep stacking pit accommodates six generator stators at the same time for stacking laminations. Each of the six stations has its own hydraulically operated press.

World's largest adjustable rail milling machine, capable of work equivalent to three 18-ft planers, saves time by allowing work to be set up on one table while machining proceeds on the other. Shown here machining a 225,000-kw generator stator frame, this mammoth unit stands 35-ft high, is 120-ft long and weighs 1,230,000 pounds.

General Electric is helping to meet tomorrow's power demands . . . today

To keep pace with the tremendous design advances of tomorrow's powermakers, new manufacturing techniques are continually being developed, and additional unique production tools are being designed and built. Already, electronic and magnetic tape controls are being applied to increase speed and improve accuracy of some machining processes.

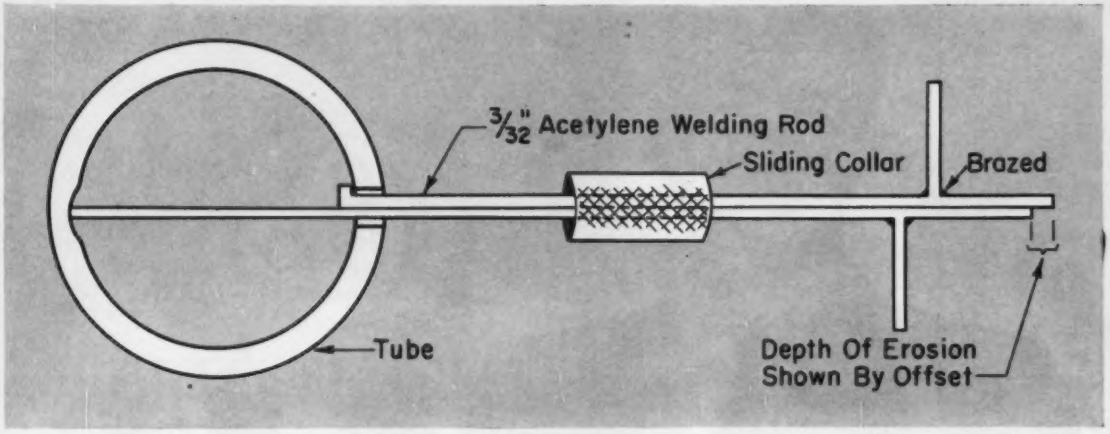
Such forward-thinking investment in new tools and facilities for building large steam turbine-generators gives assurance that General Electric will continue to help the electric utility industry maintain its spectacular record of meeting the nation's constantly expanding power needs. Large Steam Turbine-Generator Department, Schenectady, New York. 254-54



Larger units, ranging up to 450,000 kw in size, are now being designed and built. Historical growth in average size of powermakers shipped from Schenectady is shown here.

Progress Is Our Most Important Product

GENERAL ELECTRIC



GENERATION—Maintenance

Gauges Studded Boiler Tube Erosion

R. S. LEASE, Shift Operating Engineer, Ohio Valley Electric Corp, Gallipolis, Ohio

Cavitations inside studded boiler tubes along chill-rings presented the problem of determining the remaining tube thickness. Erroneous results might occur if the studs were drilled or first ground off and then drilled.

The depth of cavitation can be ascertained by drilling a $\frac{3}{16}$-in. hole in the rear of the tubes and inserting the gage illustrated after carefully deburring the hole. The gage part with the hooked end is inserted first and drawn until it hooks the tube. Next the straight shank is inserted until it "feels" the far side of the tube. Then the offset at the outer ends of the gage will indicate the depth of erosion if those ends were previously ground flush with each other when inserted in a new tube for calibration. The original tube thickness minus the gage offset indicates remaining wall thickness.

The gage determines whether deep corrosion exists on the inside surfaces of studded boiler tubes, but is not intended to yield an absolute measure of remaining tube-wall thickness.

DISTRIBUTION—Construction

Air-Driven Auger Cuts Manhours 60%

R. K. WOODSON, Assist Superintendent, Underground Department, Kansas City Power & Light Co, Kansas City, Mo.

An auger driven by compressed air reduced by 60% the manhours required for drilling holes for small cable that crosses streets or driveways in this service area.

The compressed-air auger drills a 3-in. hole, instead of the smaller one drilled by a hand auger. The larger hole has proved more satisfactory. Holes can be drilled up to 8 in. in dia by changing bits.

D. B. LAWTON, General Manager of General Electric's Medium Transformer Department, is shown with a model of the standard-design RM transformer. These transformers are manufactured in General Electric's $25,000,000 facilities in Rome, Georgia.

A GENERAL ELECTRIC 10-YEAR FORECAST:

$40,000,000 electric utility savings with medium transformer standardization

Based on today's eight percent lower price of standard ratings compared with specials, America's electric utilities stand to save—in the next 10 years—more than $40,000,000 on medium transformers (501 to 7500 kva, 69 kv and below). So forecasts D. B. Lawton, General Manager of General Electric's Medium Transformer Department, Rome, Georgia.

This $40,000,000 savings figure is conservative. Based on present standard-versus-special buying practice, it will be greatly exceeded if the utility industry continues to increase its acceptance of standards as in the past few years.

The tremendous saving due to lower prices is but one of the many benefits of medium transformer standardization. The modern, repetitive manufacturing facility put in place by General Electric at Rome in 1953 also makes possible:

Faster shipment—Ten-week shipment is now average for General Electric RM medium transformers. This compares with an industry average of more than 16 weeks for specials.

More and better features—Standard design has made it economically possible for General Electric to offer such important extras as Formex* insulated windings, control-center arrangement of instruments and accessories, reversible junction boxes, full drain, and many others.

Higher quality for longer life—General Electric repetitive manufacture techniques permit 18 assembly-line tests and 22 quality control inspections during manufacture, to assure dependable operation over a long service life.

G.E.'S BROAD RANGE OF STANDARDS HANDLES 90% OF ALL JOBS

If your company is not yet taking full advantage of the large dollar savings and other key benefits of medium transformer standardization, act today. Ask your G-E Apparatus Sales Engineer to show you how G.E.'s broad range of standard RM medium transformers can meet the large bulk of your needs, work efficiently with older, special transformers now on your system. General Electric Company, Schenectady 5, New York. 416-7

*Reg. Trade-mark of General Electric Company

Progress Is Our Most Important Product

GENERAL ELECTRIC

Suspending Aerial Cable on Line Poles

Methods are shown for suspending 5-kv preassembled aerial cable on a typical line pole from tangent up to 45-deg angles and on a typical angle and corner pole for angles above 45 deg. This presentation is adapted from Distribution Standards of New England Electric System.

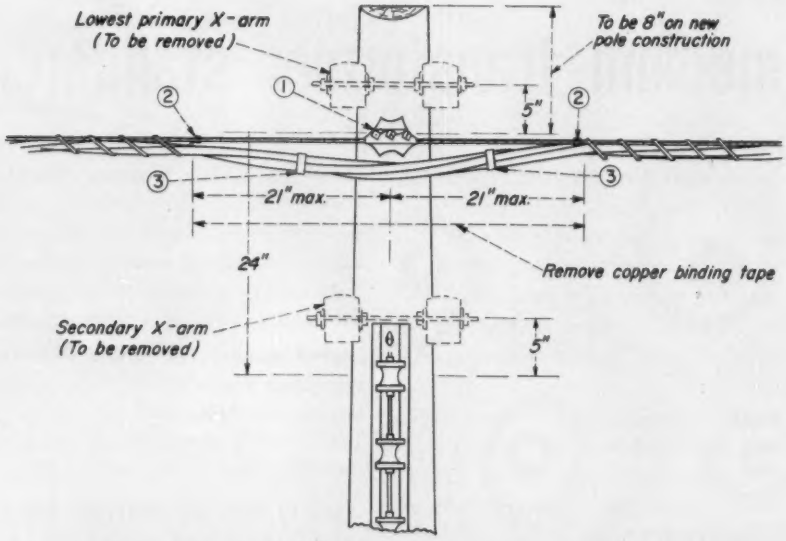


Fig. 1—Typical Line Pole for Angles Up to 45 Deg

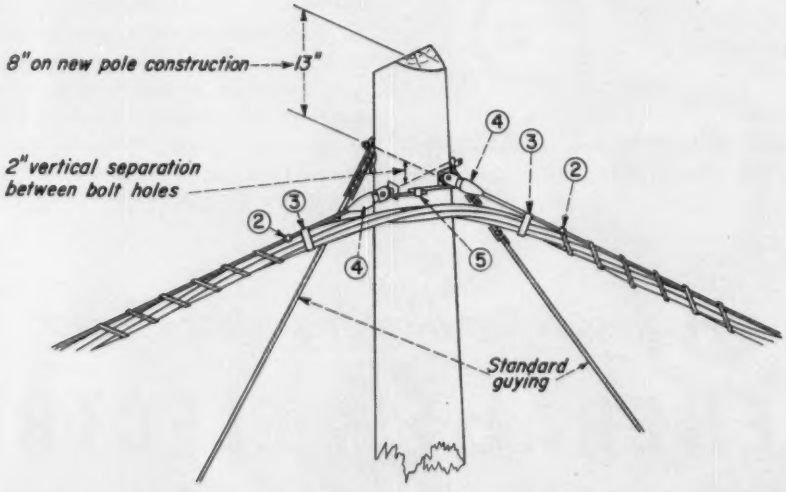


Fig. 2—Typical Angle and Corner Pole for Line Angles Above 45 Deg

MATERIAL LIST

1. Suspension Clamp
2. Lashing Fasteners
3. Cable Supporting Bands, two
4. Messenger Deadends, two
5. Messenger Connector, standard item

A General Electric Voltage Regulator Engineer Asks . . .

WHY UNTANK IT AT ALL?

By D. D. MacCarthy

Manager—Engineering
Voltage Regulator Product Section
General Electric Company

One very important point has been left out of recent discussions on "ease of regulator untanking":

On the average, the General Electric ML-32 step voltage regulator doesn't have to be untanked at all until after 20 to 25 years of service.

This point, I think, is important because it tends to put this "ease of untanking" feature in its proper perspective.

Whereas we design the ML-32 to be reasonably easy to untank, this is not our primary interest. We believe that a regulator should be on the line "open for business" rather than off the line "open for repairs."

Here are six of the many *exclusive* G-E features we build into the ML-32 to make untanking a seldom-needed thing:

1. *Tap Leads* are brought directly to the tap switch, thus eliminating about 20 connections in the power circuit.

2. *Internal Thyrite* by-pass resistor* is closely coordinated with series winding insulation for maximum protection. Since it is an *internal* by-pass it is not subject to external damage.

3. *Switch insulation strike and creep distances* are more conservative than other regulators. Moreover . . .

4. *Electrostatic shielding* prevents excessive carbon accumulation at critical points on insulating panels. This means long insulation life, even in carbonized oil.

5. *Optimum-life switching,* with speed controlled by impeller, gives extra-long switch life. Arconite switch contacts are of ample size for long life.

G.E.'s ML-32 is designed for 20 to 25 years of dependable, on-the-line service.

6. *Spring-driven Geneva-gear switch drive* has the simplest construction of any regulator. This means fewer parts to cause trouble.

As a further testimonial to the ML-32's mechanical and electrical strength, G.E. is, to my knowledge, the only manufacturer who guarantees a successful tap change under short circuits—including a guarantee of withstanding short-circuit forces at all load-bonus positions.

So, although I agree it's a good thing to take a regulator apart every couple of decades, I still ask: "Until then, why untank it at all?"

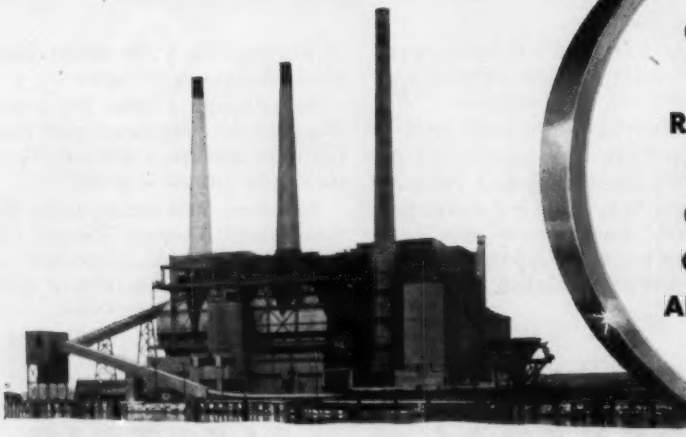
For more information, write Section 423-20, General Electric Co., Schenectady 5, N.Y., or contact your General Electric sales office or agent.

**Reg. Trade-mark of General Electric Company*

Progress Is Our Most Important Product

GENERAL ELECTRIC

The bigger the condenser the



ALLIS-CHALMERS CONDENSER THAT WILL SERVE THE #2 UNIT, RIVER ROUGE STATION, DETROIT EDISON CO., CONTAINS 249,000 LBS. OF REVERE ARSENICAL ADMIRALTY CONDENSER TUBES

more it needs the dependability of

Revere Quality Tubes

When condensers get to be the size of this one made by ALLIS-CHALMERS (even bigger ones are now being constructed) owners can't afford the luxury of failure.

In order to leave nothing to chance, engineers of the Detroit Edison Company consulted with Revere Technical Advisors on the operating conditions under which the tubes would have to give service. Many different alloys were considered. The final decision was Revere Arsenical Admiralty Metal for the Tubes and Muntz Metal for the Tube Plates.

This final decision was based on a combination of the experience of Detroit Edison Engineers and Revere's wide experience in the condenser tube field, and the tremendous amount of research and laboratory work done in determining the relative corrosion resistance of the different alloys under a wide variety of operating conditions.

Since there are variable factors in practically every condenser tube installation, why not take advantage of this storehouse of facts and consult with Revere's Technical Advisory Service before making your tube commitments?

Revere furnishes plates, from the smallest to the largest sizes, in Cupro-Nickel, Copper, Herculoy, Muntz Metal, Naval Brass and Admiralty, and tubes in Cupro-Nickel, Aluminum Brass, Admiralty, Herculoy, Arsenical Copper, Muntz Metal and other alloys.

PLACING ONE OF THE 19,850 TUBES in the condenser for the new 265,000 KW turbine generator unit #2 at the River Rouge Station of DETROIT EDISON COMPANY. Tubes are ¾" O.D. x 18 BWG x 30' long and are Revere Arsenical Admiralty Metal. Tube sheets are Revere Muntz Metal. A lasting combination!

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

Mills: Rome, N. Y.; Baltimore, Md.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Brooklyn, N. Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities, Distributors Everywhere.

From the ranges in the kitchen . . .

To the milker in the barn . . .

Kwhrs Replace Man-hrs on an All-Electric Farm

Robert Nortier may have achieved the ultimate in farm electrification on his dairy and poultry farm near Rochester, N. Y.—and it's paying off.

"I use electricity because I can't depend upon a good supply of hired help," says Nortier. "I estimate my labor cost would be over $5,000 a year. Contrast this with my present expenses—$475 for electricity for all farm operations. Interest and depreciation on an investment in equipment of $15,000 comes to $2,400 annually; say $300 for repairs; and you have a total yearly cost of about $3,200. Believe me, it's a lot more reliable than hired help!"

Rochester Gas & Electric Corp has served the Nortiers for 28 years. September 6-8 agricultural leaders from all over the state were invited to the farm for a look at how kilowatts do the Nortiers' chores today.

An electric milking machine pipes milk directly from cow to cooler. Two fan-propelled hay driers prepare the feed. Hay is even pitched by power-driven devices.

The milkhouse is electrically heated. The barn is well lighted and fan-ventilated. To make the cows still more content, radio music is played in their quarters. The cows gratefully produce more and better milk.

Nortier even cleans the manure out of his barn electrically. A flip of a switch and the gutter cleaner scoots it right into the manure spreader.

In the chicken house, 1,500 laying hens are fed and watered automatically. Lighting, on a time switch, lengthens their working day. Baby chicks are brooded in a 30x50-ft insulated brooder house, where they nestle comfortably on a concrete floor laced with heating cable.

The egg room is now air conditioned, "but," says Nortier, "although it makes it very comfortable in here on a hot day, the air conditioner removes too much humidity from the air for the perfect keeping of eggs." The ¾-ton unit will soon be moved to the house, and replaced with an electric egg-room cooler.

When fire destroyed their house last year, the Nortiers rebuilt with comfort in mind. They installed an all-electric kitchen and all-electric heating with a thermostat in every room. Mrs Nortier's washer, drier, dishwasher and freezer save her so much time she is able to help her husband in the egg room.

Both Nortiers agree that they could never carry on the dairy and poultry projects they do without help from their "cheap hired hand"—electricity.

Laura McCall Award Will Go to Top Home Service Woman

McCall's magazine has invited all women in the home service departments of the nation's utility companies to compete for this year's Laura McCall Awards for Home Service Achievement.

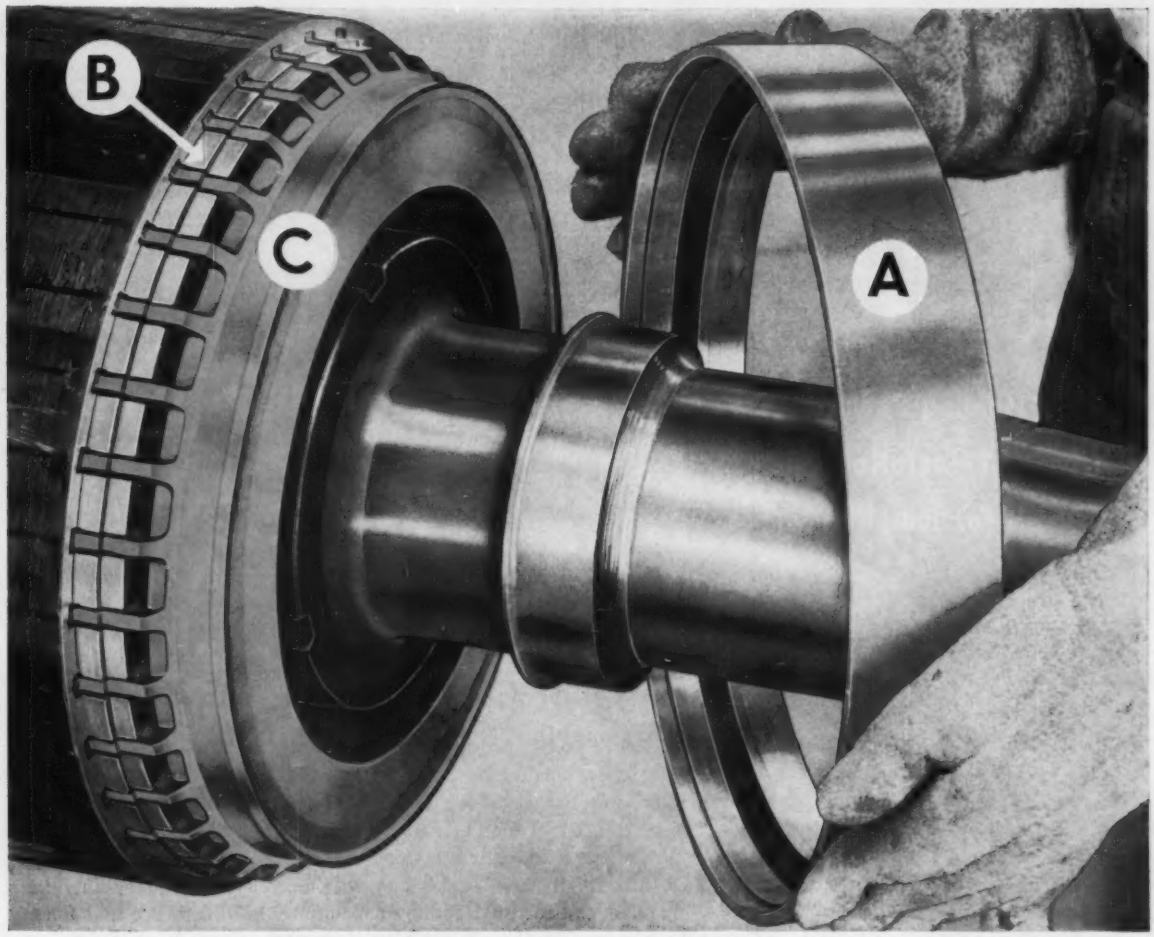
Any woman on the home service staff of an electric utility that supplies service to residential customers is eligible for the award. Winners will receive a $200 check and a plaque for their company.

Five Awards will be given in three divisions. Division A is open to heads of home service staffs with 10 or more assistants. Division B is for staff-heads with less than 10 assistants. Division C has three Awards open to individual staff members.

Entries to the competition must describe home service programs and activities carried on or developed during the year ending Aug. 31, 1957. Entries must be postmarked before midnight, Dec. 1, 1957.

Awards will be given Jan. 8, 1958 at The Electrical Women's Round Table convention in Chicago.

(*More Selling on page* 144)



Retainer ring construction is used in E-M Induction Motors rated 900 hp and larger at 3600 rpm, and 1750 hp and larger at 1800 rpm. It's just one of many special features built into every large, E-M Induction Motor.

"Ring around the end ring" locks

Rotational Stability...

into BF pump motors

"I'm Ev Jernberg, Chief Mechanical Engineer at E-M. Over the years we've learned a good deal about building big induction motors. One problem was to retain rotational stability on high-speed applications.

"At E-M we 'lock' precise factory balance into our rotors by shrinking accurately machined, non-magnetic alloy retaining rings around the cage end rings. This supports the 'floating' end rings against centrifugal force and anchors them to the shaft. The retainer (A) is shrunk onto the shaft-connected, rotor endplate (B) and locks the 'floating' end ring (C) perfectly concentric to the shaft. The possibility of unbalance from centrifugal and thermal distortion of the cage winding is thus permanently eliminated."

For further information about E-M Motors, call your nearby E-M Sales Engineer and write for brochure PRD-214.

E-M

1300-TPA-2194

ELECTRIC MACHINERY MFG. COMPANY

Minneapolis 13, Minnesota

Specialists in making motors do

EXACTLY WHAT YOU WANT THEM TO

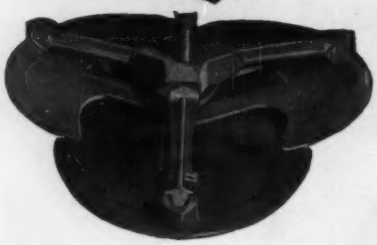
The Old Reliable

EVERSTICK ANCHORS...

EXTRA Holding Power

QUICKLY Installed

TOUGH For long life

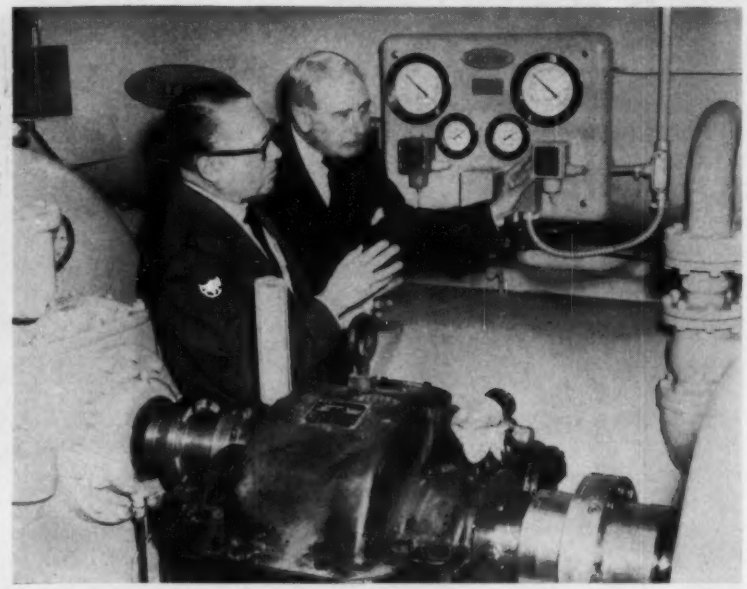


● They speed up work and provide dependable anchorage in new construction and maintenance. Quick and easy to install—made of tough rust-resistant malleable iron—their holding power "tops" all other. Available two-way, three-way, four-way, and cone types. Write for facts.

AN EXCLUSIVE EVERSTICK FEATURE
Exclusive Everstick nut housing Locks anchor firmly on rod. No chance of rod slipping thru anchor.

EVERSTICK ANCHOR CO

FAIRFIELD, IOWA



Rockefeller Center Takes A.C. Lead

As G. S. Eyssell, president of Rockefeller Center, Inc, and Cloud Wempler, board chairman of Carrier Corp, pressed a button, Rockefeller Center became the world leader in office air conditioning September 19.

Addition of 1,100 tons of cooling capacity boosted Rockefeller Center past the Pentagon into the number 1 spot, with a total rated capacity of 15,382 tons. And New York's city within a city is not stopping there.

"Our plans call for total cooling capacity of 17,700 tons," said Eyssell. "At the present time the refrigeration cycle in the Center's air conditioning program is 85% completed."

Public Service Co Plans Resistance Heating Show

Electric heating is getting some serious consideration in the Northeast. Public Service Electric & Gas Co (N. J.) is inviting manufacturers to aid in setting up an Exposition of Electric Resistance Heating in its Newark Auditorium, Oct. 23-24.

The idea is to show off as many types of resistance heating as possible, and to emphasize their great potential market for supplemental heating in bathrooms, enclosed porches, and house additions.

So far 34 manufacturers have been invited to exhibit, at no cost for space. Public Service reports an enthusiastic response. The North Jersey Chapter of the American Society of Heating and Air Conditioning Engineers has also asked for space.

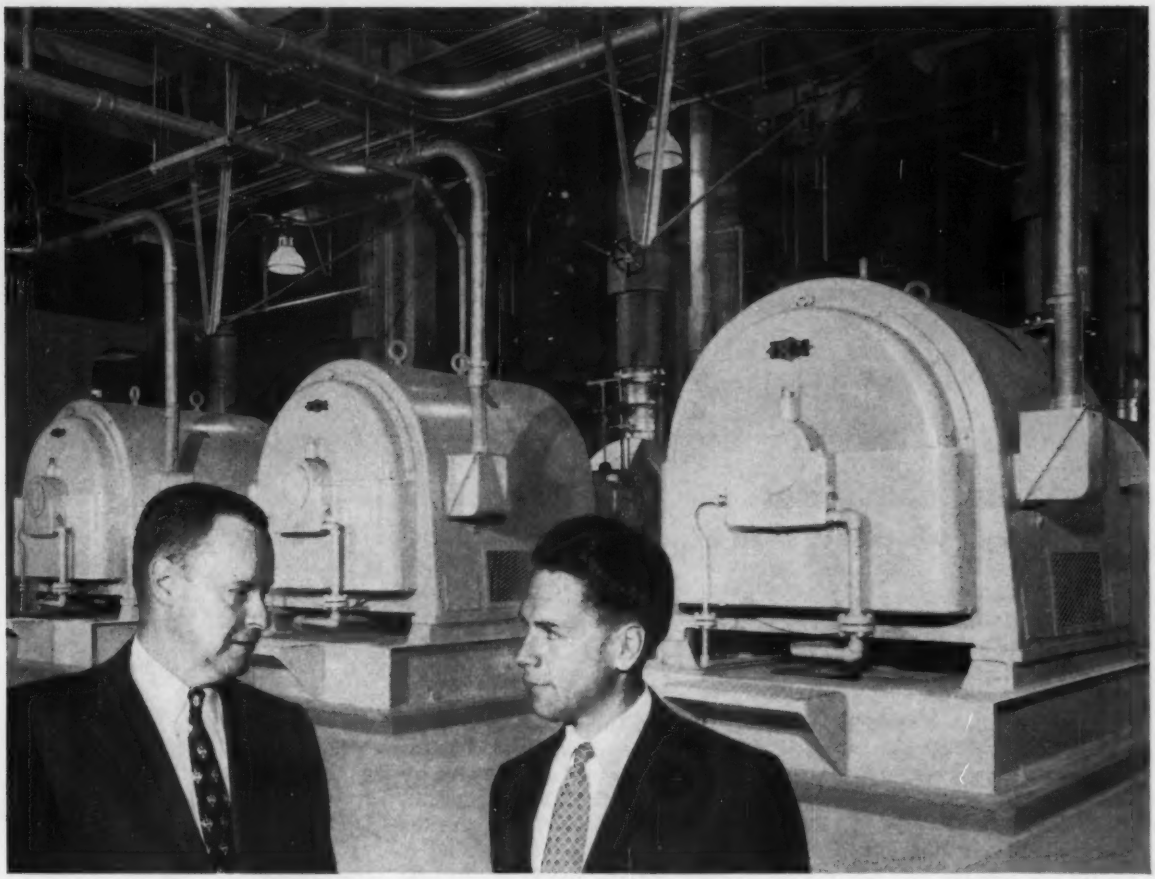
Architects, builders, electrical contractors and distributors, and heating and air conditioning distributors, as well as the general public, will receive invitations to the exposition.

H & C BRIEFS

More Heat Pumps in Washington

Heat pumps are becoming increasingly popular in the Washington, D. C. area. An even hundred pumps are in operation now, and 56 more are being installed. Making up the 322 tons of heat pumps to be installed are 44 five-ton, five 3-ton, one 7.5-ton, four 10-ton, and two 20-ton units.

(*More Selling on page* 146)



Gerry Oscarson, Chief E-M Application Engineer, points out to Ev Jernberg, Chief E-M Mechanical Engineer, the excellent on-the-job dependability record of three, 1500 hp, 3600 rpm E-M Induction Motors driving BF pumps at a big, upper midwest power plant.

These motors show that E-M locked-in

Rotational Stability...

keeps BF pumps running smoothly

"You know, Ev, these three E-M Induction Motors have been on duty here for 24 hours a day for the past four years. The extra pains we take at the factory to make sure our motors keep their perfect balance looks like it's paying off in smooth service and low maintenance."

"That's right, Gerry. Our method of securing the cage end rings with shrunk-on, high strength alloy retaining rings has certainly worked well. Even heavy centrifugal and thermal stresses can't damage these cages. The specially designed retaining ring gives our customers the dependability they need in high speed auxiliary drives."

You, too, can benefit from the special attention E-M gives to rotational stability. Write the factory for Induction Motor brochure PRD-214, and call your nearby E-M Field Engineer for firsthand information about dependable Induction Motors.

E-M

1300-TPA-2198

ELECTRIC MACHINERY MFG. COMPANY

Minneapolis 13, Minnesota

Specialists in making motors do EXACTLY WHAT YOU WANT THEM TO

Men get light where they need it . . .

illumination jumps 200% as . . .

Engineered Lighting Boosts Efficiency

H. M. **WHITE**, Industrial Power Engineer, Baltimore Gas & Electric Co, Baltimore, Md.

A well-engineered factory lighting system that puts the light where it is needed has boosted the operating efficiency, improved the flow of work, and increased working comfort at the Continental Can Co machine shop in Baltimore. The installation is of immeasurable help for overtime work that once required use of hand lamps and drop cords. Boosting the general illumination level in the work areas to 40 ft-candles, in contrast to the previous 12 to 15, the system eliminates the need for supplementary lighting.

Each 20x20-ft bay in the working area has four two-lamp slimline porcelain RLM units, eight feet long, suspended nine feet above the floor. Total installation uses 112 fixtures. Operated at 120 v, the total load of the new lighting is approximately 22 kw.

Before the system was selected, a careful study of the illumination requirements was made. Light was applied where it would pay dividends in work results. Where it was adequate the old lighting system was retained.

Under the old system, each bay had four 200-w glassteel diffusers. Despite the huge increase in the lighting level, power costs for the new system are approximately the same as they were with the incandescent lighting.

450 Kc Speeds Tool Output

L. M. **DURYEE**, Division Industrial Sales Engineer, Connecticut Light & Power Co, Waterbury, Conn.

Three hundred tools a day is the capacity of this 25-kw, high frequency, induction heating machine at the Vickers, Inc. plant in Waterbury, Conn. Used principally for high temperature brazing of high speed tools, this versatile machine may also be used for a wide variety of other heating jobs.

The three-phase oscillator operates from a 460-v line, has a 450-kilocycle operating frequency. Illustration shows high speed carbide tips being brazed on tools. With its high rate of production, the machine has already paid for itself many times in four years of use, according to the engineer in charge of the operation.

An ounce of scientific prevention

Like the dramatic progress in medical science, modern tree care bears little resemblance to the crude methods of only fifty years ago. No longer is it enough to repair damage—to cut away a limb that has died. Today, as always, we seek the answer "Why"—the cause of the damage or disease and apply every modern technique and curative treatment. Only in this way can America's rich heritage of shade trees be preserved.

Scientific tree care is available to you through your local Bartlett representative, a highly skilled technician backed by the knowledge and experience of the Bartlett Tree Research Laboratories. If you have trees which you value, it will pay you to consult him before you need him. No one knows better than a Bartlett client, that an ounce of scientific prevention is worth many many pounds of cure.

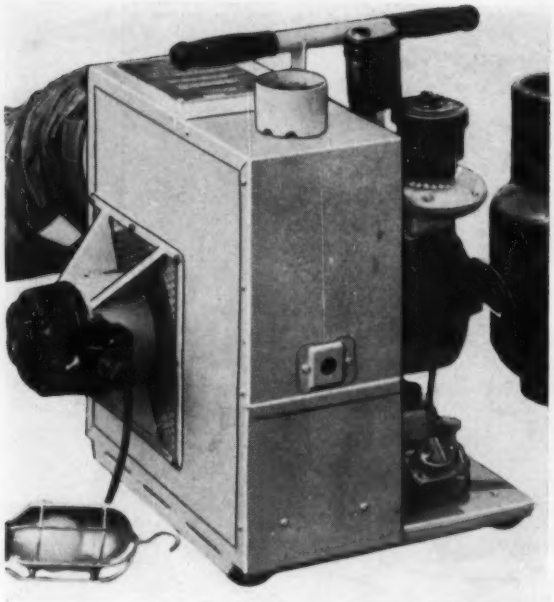
REMEMBER

Our long experience in working with both utilities and the public is your assurance of dependable work and good customer relations.

1907-1957 The Bartlett Way 50 years Progress in Scientific Tree Care

BARTLETT TREE EXPERTS

Home Office, Research Laboratories and Experimental Grounds, Bartlett School of Tree Surgery, Stamford, Conn. Local Offices from Maine to the Carolinas, and West to Indiana. See your Local Telephone Directory for Local Address.



Manhole Ventilating Heaters...

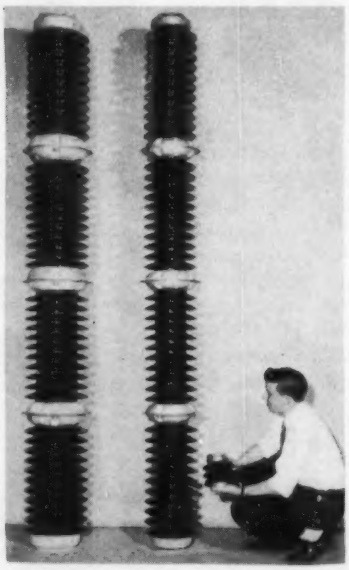
. . . have 160-w generator attached, allowing manhole crews to use a 100-w soldering iron and electric light at the same time. The propane-fed PEG blows from 300 to 800 cfm fresh air in summer and heated fresh air in winter. Burner is capable of providing 96 deg temperature rise, enabling splicers to work fast in the hole despite zero weather outside.

Controlled flow of surface air prevents accidents due to explosion, toxic gas poisoning, and heat stroke. The PEG weighs 74 lb, and is equipped with carry-handle. **Morrison-Pelsue Co, 2256 S. Delaware St, Denver 23, Colo.**

Station Post Insulators . . .

. . . for extra-high-voltage switch and bus duty deflect half as much as conventional pin-type stacks. Available in two BIL series—1,300 kv and 1,470 kv withstand—in standard or high-strength ratings, the posts are assembled with just 20 bolts. Four fog-type porcelains comprise each assembly, giving each stack only eight cemented joints. The station posts sacrifice no strength in attaining the rigidity to assure switch alignment. They are also free from radio and TV interference, puncture-proof, crack-resistant, and self-cleaning.

Lapp Insulator Co, Inc, Le Roy, N. Y.

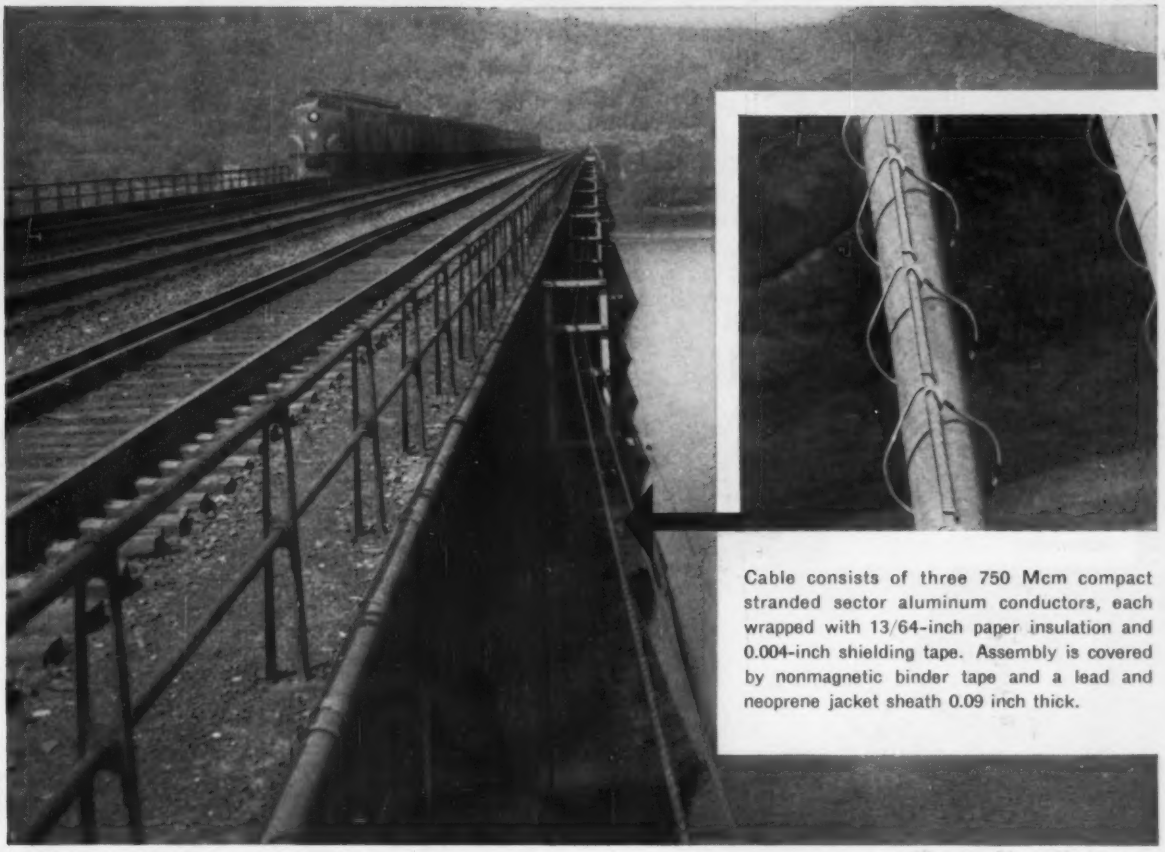


Grounding Clamps . . .

. . . with increased jumper-terminal capacity are stronger and lighter than previous types. Made of aluminum alloy and bronze, the clamps are available singly or in clusters, in eyescrew type or mounted on plastic-coated poles. Cable-insulation anchor straps on the clamps grip 5,000-v grounding cable firmly.

A. B. Chance Co, Centralia, Mo.

(*More New Equipment on page* 152)



Cable consists of three 750 Mcm compact stranded sector aluminum conductors, each wrapped with 13/64-inch paper insulation and 0.004-inch shielding tape. Assembly is covered by nonmagnetic binder tape and a lead and neoprene jacket sheath 0.09 inch thick.

SUSQUEHANNA RIVER CROSSING

Pennsylvania Power & Light Company uses neoprene to guard cable against vibration and elements

When Pennsylvania Power & Light Company attached a 15 Kv cable to a railroad bridge across the Susquehanna River near Harrisburg, it specified a neoprene jacket. The lead-covered cable had to be guarded against mechanical damage from vibrations set up by passing trains, and protected from constant exposure to the elements.

The neoprene protective covering cushions the cable, reducing the effects of vibration and the risk of scoring the lead sheath. This extra layer of protection prolongs the useful life of the lead.

This installation is another example of the accepted reliability and long life of neoprene. Of all resilient materials, only rugged neoprene has balanced resistance to sunlight and weathering, oils and chemicals, heat, flex cracking, abrasion and cutting, oxidation and aging.

Ask your supplier about wire and cable jacketed with neoprene. It's available in single and multiple conductor types and voltage ratings to meet your requirements. Mail the coupon below to get the ELASTOMERS NOTEBOOK with actual on-the-job reports of neoprene's performance in a wide range of industrial products.

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Better things for better living
. . . through chemistry

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— made by Du Pont for 25 years

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Wilmington 98, Delaware

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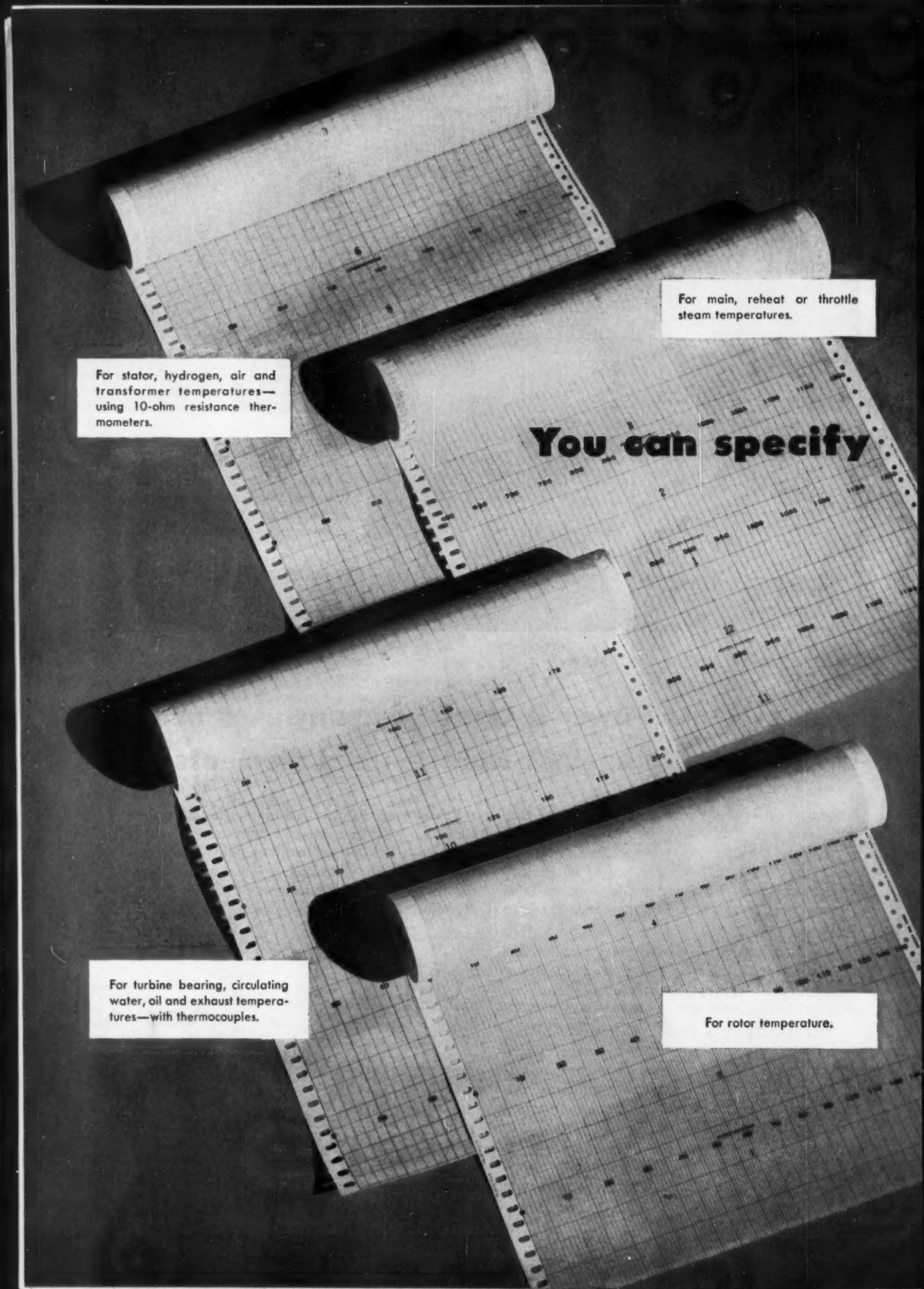
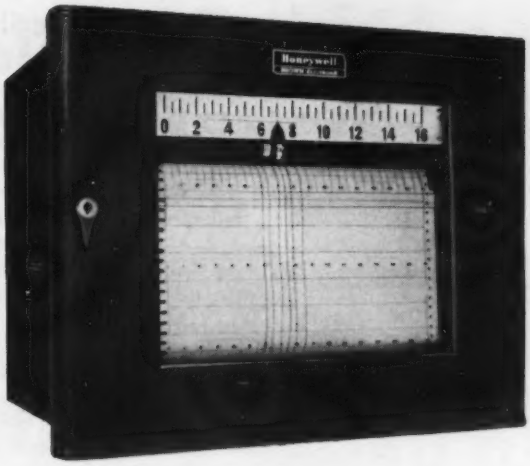
Address_____
City, State_____

MAIL THIS COUPON NOW . . . WHILE YOU'RE THINKING ABOUT IT


You can specify
For stator, hydrogen, air and transformer temperatures—using 10-ohm resistance thermometers.
For main, reheat or throttle steam temperatures.
For turbine bearing, circulating water, oil and exhaust temperatures—with thermocouples.
For rotor temperature.



ElectroniK strip chart recorders can be supplied for power plant use with scores of different temperature calibrations. Some of the typical standard charts are shown on the opposite page. Actual chart size is 11 inches in calibrated width.

an *ElectroniK* recorder

. . . for any of your temperature measurements

LET *ElectroniK* recorders keep constant watch over your plant temperatures—accurately, efficiently.

Choose one *ElectroniK* instrument to record a single temperature, or another to combine as many as twenty temperature records on a single chart. When several temperatures are combined on one chart, correlation is simple . . . operators can keep close check on trends . . . engineers can analyze operation in accurate detail.

Built-in circuits adapt these recorders for signalling excess temperatures. And there's a complete Honeywell line of thermocouples, extension wires, and power-plant-type resistance thermometers to work with *ElectroniK* instruments.

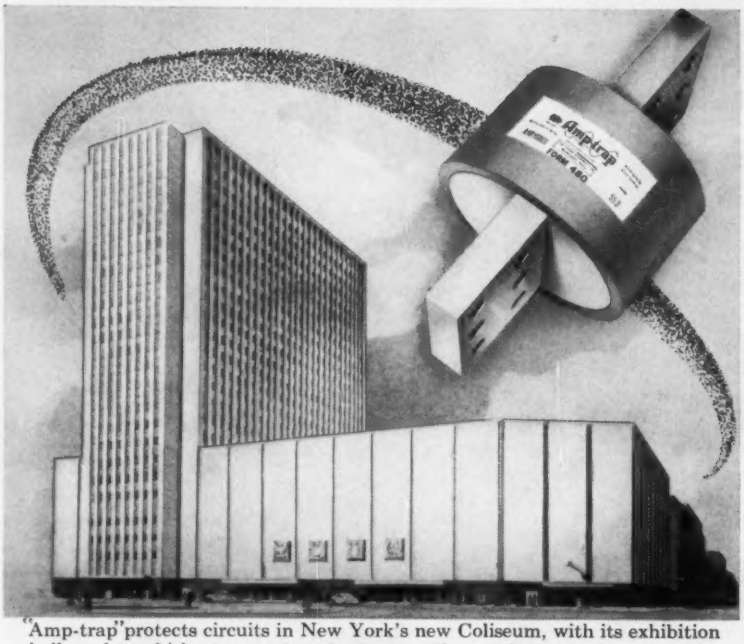
ElectroniK instruments are famous for their stamina and dependability. For a discussion of how they can be applied to measuring your plant temperatures, call your local Honeywell field engineer. He's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA: Write for Bulletin 9070, "Instruments for Electrical Power Generation."**

Honeywell

H HONEYWELL First in Controls



"Amp-trap" protects circuits in New York's new Coliseum, with its exhibition halls and amphitheatre, against the danger of heavy short- circuit or fault currents, regardless of varying load requirements.

SHAWMUT'S FORM 480 Amp-trap®

FOR APPLICATION ON ENTRANCE SWITCHES, BUSWAYS, FEEDER SERVICES AND CIRCUIT BREAKERS
ON AC CIRCUITS UP TO 600 VOLTS
ON DC CIRCUITS UP TO 250 VOLTS

- Positive Protection against Super currents as high as 500,000 peak amperes available.
- Built in Ampere Ratings of 600, 800, 1000, 1200, 1600, 2000, 2500, 3000, 4000, 5000 and 6000.
- Sharp Current Limitation Characteristics for Backup Protection of Air Circuit Breakers, Switches, etc.
- Easily Adaptable into Busses, Bus Ducts or Switches.
- Economical in First Cost and Replacement.
- Very Low Watt Loss — Cool Operation.

Copyright 1957, The Chase-Shawmut Co.

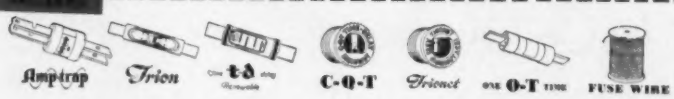
OVER 60 YEARS FROM EDISON TO ELECTRONICS

480-Amp-trap® — "Awake At The Switch"

THE CHASE-SHAWMUT CO.

373 MERRIMAC STREET • NEWBURYPORT, MASSACHUSETTS

Subsidiary of I-T-E CIRCUIT BREAKER CO., Philadelphia, Pennsylvania



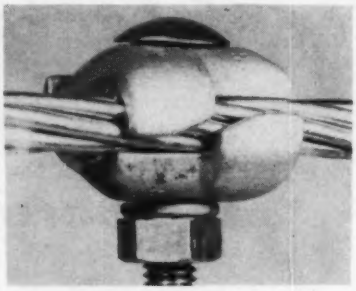
Service Entrance Sleeve . . .

. . . **has conductive end-seals** of aluminum-sensitized tape. Tape is easy to puncture, and if a particle is pushed into the chamber it does not spoil contact. Other features:

1. Color coding is printed (not indented) for easy reading.
2. Variable hole depth, increasing with size of conductor, provides greater contact area where needed.
3. Measured amounts of inhibitor in sleeves will not squirt out.

Many sleeves are available in both ½- and ⅝-in. diameter.

Jasper Blackburn Corp, 1525 Woodson Rd, St. Louis 14, Mo.



Parallel Clamp . . .

. . . **is cast from aluminum alloy,** treated to prevent oxidation. Tightened by galvanized-steel bolt, nut and lockwasher, fingers enclose aluminum or copper conductor from No. 6 stranded to 1/0 ACSR, providing high wrap-around and resistance to creep.

Penn-Union Electric Corp, Erie, Pa.

Steam-Jet Cleaner . . .

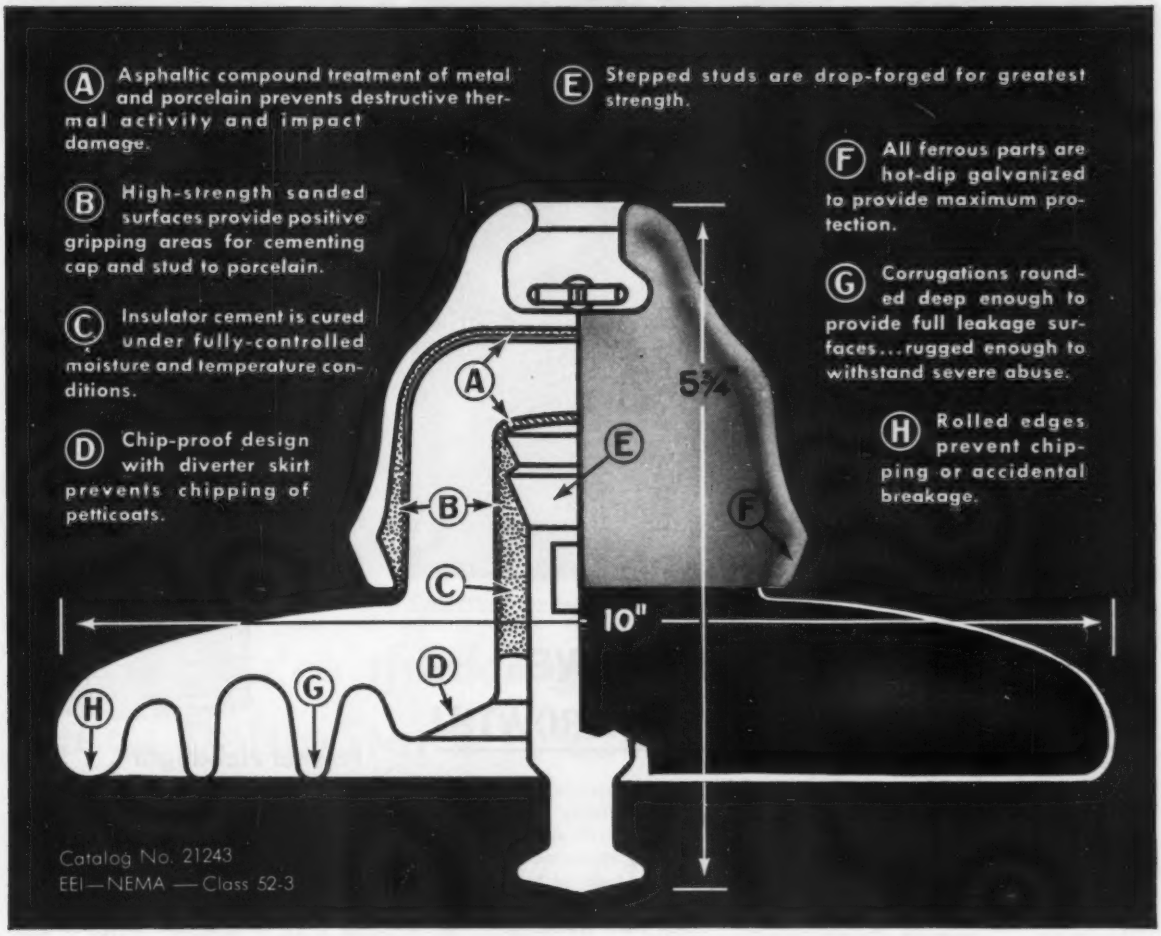
. . . **draws less power** due to high efficiency jet nozzle. Previously rated at 30 kw, "Speedylectric" cleaner now carries 20-kw rating, and usually consumes 15 to 18 kw per hr. Units for 220 v, 440 v, or 220/440 v, 3-phase, 60-cycle feature fingertip control of amount of liquid. Fire and explosion hazards are reduced to a degree permitting equipment to be cleaned in place during working hours.

Pantex Mfg Corp, Box 660, Pawtucket, R. I.

(*More New Equipment on page* 154)

Custom-Built Thomas Insulators meet severest requirements

CHECK THESE FEATURES


(A) Asphaltic compound treatment of metal and porcelain prevents destructive thermal activity and impact damage.
(B) High-strength sanded surfaces provide positive gripping areas for cementing cap and stud to porcelain.
(C) Insulator cement is cured under fully-controlled moisture and temperature conditions.
(D) Chip-proof design with diverter skirt prevents chipping of petticoats.
(E) Stepped studs are drop-forged for greatest strength.
(F) All ferrous parts are hot-dip galvanized to provide maximum protection.
(G) Corrugations rounded deep enough to provide full leakage surfaces... rugged enough to withstand severe abuse.
(H) Rolled edges prevent chipping or accidental breakage.
5¾"
10"
Catalog No. 21243
EEI—NEMA — Class 52-3

Wherever service conditions make the severest demands on insulators, a Thomas Insulator always gives complete assurance of satisfactory performance. That is particularly true of the insulator illustrated. It is designed and custom-built for installations where physical ruggedness is as important as insulating effectiveness. It fully meets all standard requirements for insulators of its type and capacity. It embodies all the tested refinements of construction and design which assure longer service life and superior performance. Write today for free data sheet. Address Thomas Works, Delta-Star Electric Division, H. K. Porter Company, Inc., Lisbon, Ohio.

H. K. PORTER COMPANY, INC.

DELTA-STAR ELECTRIC DIVISION

Divisions of H. K. Porter Company, Inc.: Cleveland, Connors Steel, Delta-Star Electric, Henry Disston, Leschen Wire Rope, Quaker Rubber, Refractories, Riverside-Alloy Metal, Vulcan Crucible Steel, W-S Fittings, H. K. Porter Company (Canada) Ltd.

Here's a cable supporting system with space reserved for future needs

COPE CABLE TROUGH GIVES YOUR SYSTEM ROOM FOR GROWTH!

Cope cable trough design gives you greater load carrying capacity per dollar *now—plus built-in system expansibility* that will minimize the cost of future system expansion. A *single* 24″ wide section of Cope cable trough supports as many cables as 16 lengths of 4″ conduit. Additional cables can be quickly and easily laid in *existing* trough as new equipment installations require. The lower *first* cost of a Cope cable trough installation *saves you money a second time* when you need to increase or expand your power distribution system!

Reduced System Maintenance Costs. Easy-to-get-at Cope cable trough also eliminates costly maintenance problems down the line. Once cable is laid in Cope expanded metal trough, it's readily accessible for easy inspection, repair . . . or *re-routing* when system changes are required. And greater installation flexibility of lightweight Cope cable trough and a complete line of system accessories and fittings reduce design time up to 25% for laying out the most complicated system . . . assure easy system maintenance even in the most cramped quarters.

Cut Costs Three Ways. You save *three ways* when you specify Cope cable supporting systems with pin-type coupler . . . trough, ladder or channel.

- **LOWER FIRST COST**
- **LOWER INSTALLATION COSTS**
- **LOWER SYSTEM MAINTENANCE COSTS**

Discuss these advantages for *your* installation with a qualified Cope representative—or write to T. J. Cope Division, Rome Cable Corporation, Collegeville, Pa.

1002

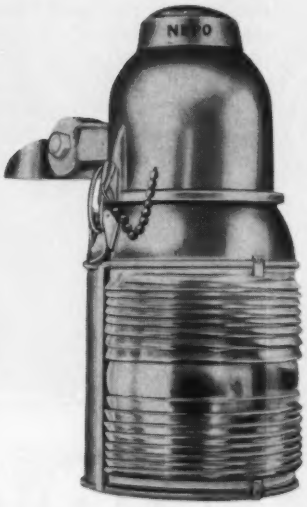
T. J. COPE *Division*

ROME CABLE CORPORATION

Sealer Paste . . .

. . . **cures without heat** allowing transformer leaks to be sealed quickly with transformer still in place. Twenty jars of black Epoxylite paste come in kit with application accessories. The chemical-resistant, adhesive insulation can also repair meter cases, ceramic bushings, and terminal boards on the spot.

The Epoxylite Corp, 10827 E. Central Ave, El Monte, Cal.



Fresnel Floodlight . . .

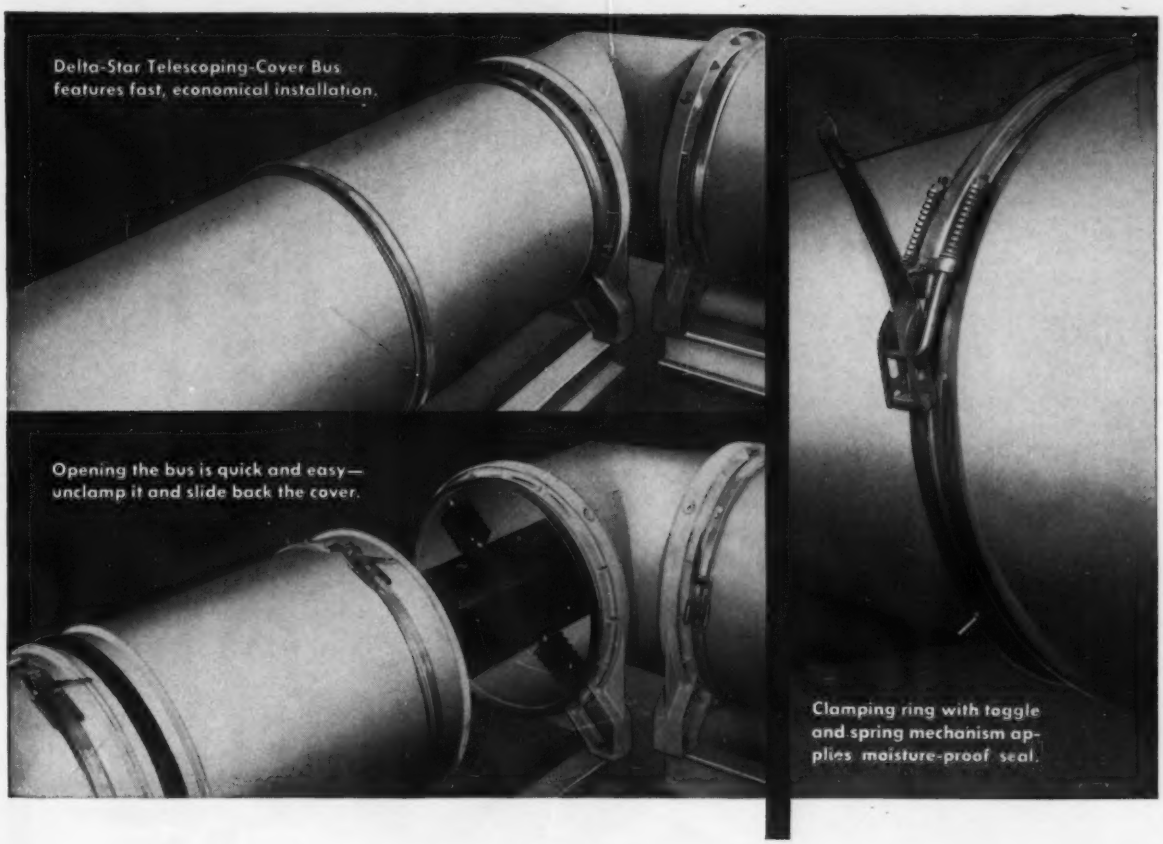
. . . **throws 180-deg beam.** Designed for protective lighting around such installations as factories, reservoirs, airports, and railroad bridges, the No. 200F can take 300- to 500-w incandescent, 4,000- to 10,000-lumen incandescent, or 100- to 250-w mercury vapor lamps. It is dustproof, weather-proof, and has a heat resistant lens.

Nepo Mfg Co, 4230 N. Sayre Ave, Chicago 34, Ill.

Ground Detector . . .

. . . **for 3-phase power systems** gives visual and audible alarm of ground faults before damage occurs. The PRD-C5700 can be set for line voltage drops as small as 1 v in systems of any voltage rating. It operates

(*Continued on page* 158)


Delta-Star Telescoping-Cover Bus features fast, economical installation.
Opening the bus is quick and easy—unclamp it and slide back the cover.
Clamping ring with toggle and spring mechanism applies moisture-proof seal.

When you're thinking about cost reduction, check Delta-Star's Telescoping-Cover Bus

From installation to maintenance you reduce time and costs with Delta-Star's telescoping-cover isolated phase bus.

Installation is greatly simplified—for speed and economy. Longitudinal sections 6 to 8 ft. long can be pre-assembled and delivered in lengths as large as your facilities can handle. Telescoping covers clamp into position—are locked together with a toggle and spring clamping mechanism—no bolts needed. Clamping rings with fully-trapped, self-sealing neoprene gaskets make the bus as water-proof as it is possible for a gasketed bus to be. Gasketing is at a minimum—no longitudinal gaskets required.

Telescoping-cover bus sections can be opened and inspected without tools—*in just a few minutes.* A 2 ft. 6 in. opening allows ample room for inspection and cleaning.

Current-carrying ability and minimum-heating characteristics of the telescoping-cover bus proved out very well in tests and in use.

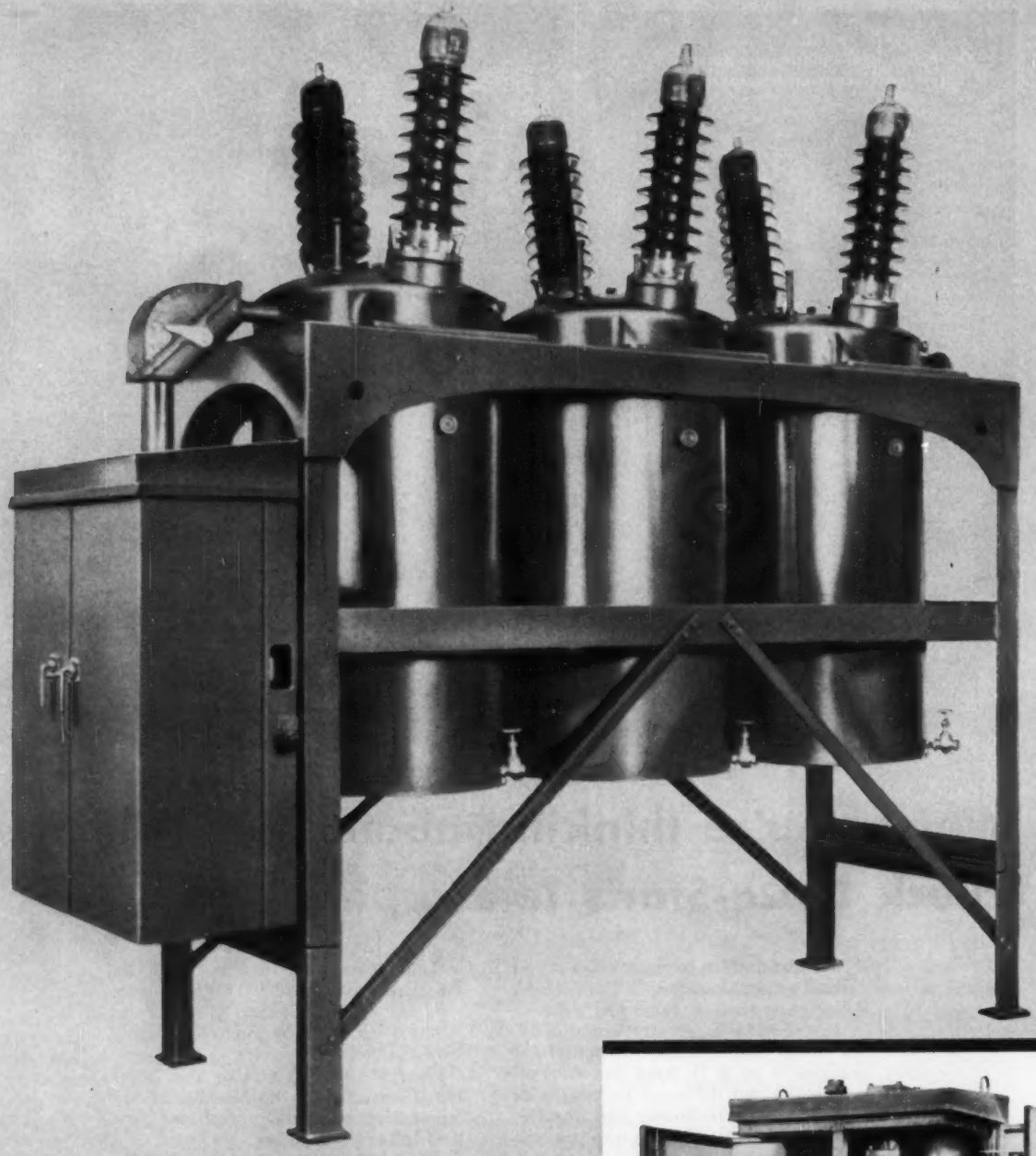
For your new bus runs—or replacements—be sure to check Delta-Star's telescoping-cover bus.

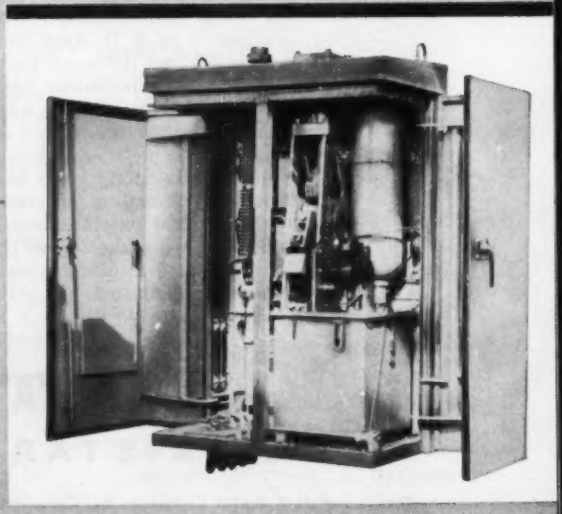
Delta-Star Electric Division
H. K. Porter Company, Inc.
Chicago 12, Illinois
District offices in principle cities

H. K. PORTER COMPANY, INC.

DELTA-STAR ELECTRIC DIVISION

Divisions of H. K. Porter Company, Inc.: Cleveland, Connors Steel, Delta-Star Electric, Henry Disston, Leschen Wire Rope, Quaker Rubber, Refractories, Riverside-Alloy Metal, Vulcan Crucible Steel, W-S Fittings, H. K. Porter Company (Canada) Ltd.





TYPE OA HYDRAULIC OPERATOR. Safe, dependable operation—ultra rapid response—smooth, shock-free performance—freedom from corrosion—100% trip-free under *all* conditions.

Introducing

THE NEW FEDERAL PACIFIC

TYPE AF

OIL CIRCUIT BREAKER

..Designed to Interrupt High Current Faults in 23, 34.5, 46 & 69 KV applications

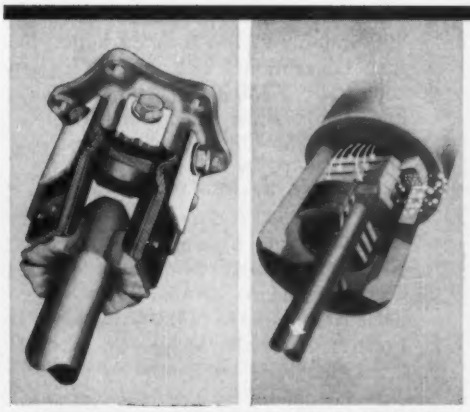
Compact...rugged...unrivaled in dependability—Federal Pacific's new high-capacity, frame-mounted Oil Circuit Breakers embody the most advanced design features to provide unmatched performance and reliability. Employing a rugged, thoroughly-tested drop-bar contact structure, the new type AF is equipped with standard ASA bushings. Two bushing-type current transformers per bushing can be provided where necessary.

Powered by the advanced type OA hydraulic mechanism, they give fast, shock-free opening and closing...and are *100% trip-free under all conditions.* The mechanical linkage is characterized by a highly efficient straight-line-drive of greatly simplified design. Subjected to the most exhaustive testing procedure—the ability of the new breaker to withstand high-current fault interruptions has been thoroughly proved. For full details, call your nearest Federal Pacific engineering representative or write for Booklet #4-540: Pacific Switchgear Division, 5815 Third Street, San Francisco 24, Cal.

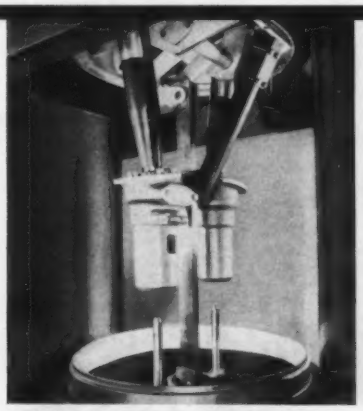
FEDERAL PACIFIC ELECTRIC COMPANY
Main Offices: 50 Paris Street, Newark, New Jersey

FEDERAL FPE PACIFIC

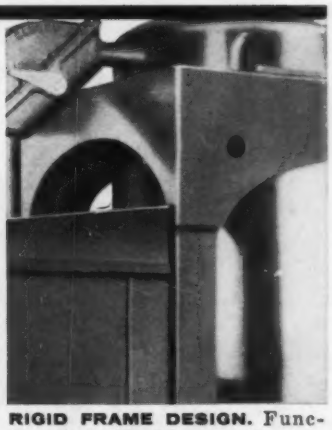
Better Products to Control Electricity



RAPID ARC EXTINCTION. Oil injection into hot gas bubble accelerates condensation and cooling ...results in high dielectric recovery rate...prevents arc re-ignition at proper gap distance—with minimum pressure build-up and erosion.



STURDY DROP-BAR CONSTRUCTION. Minimum number of components; dependable, simplified mechanical linkage; convenient adjustment; efficient straight-line-drive principle of operation; instant response; minimum space requirements.



RIGID FRAME DESIGN. Functionally designed frame with extra-strong joint construction. Inverted channel upper frame member for maximum strength and transformer lead protection.

CONTROL

CABLES FOR TOP RELIABILITY—
TYPES TO MEET ANY
SERVICE CONDITIONS

Because no single construction can give the top dependability essential to control circuits, Triangle offers several types:

Rubber Insulated—Braid Covered
An economical construction for use in permanently dry locations not exposed to moisture, oils, grease, solvents or vapors.

Rubber Insulated—Neoprene Covered
Heat and moisture resistant compounds (RH-RW and RHW) or Triozone, ozone resisting butyl insulation covered with Trioprene, a jacket so tough it can be buried directly in the earth.

Thermoplastic Insulated—Thermoplastic Covered
Insulated either with Triolene, Triangle's polyethylene, or with Trioseal, Triangle's polyvinylchloride, and jacketed with Trioseal. Tough, flexible, with good electrical and aging properties and highly resistant to moisture, oils, acids, alkalis. May also be buried directly in the earth.

Rubber Insulated—Lead Covered
For installations in very wet locations, including complete submersion.

TRIANGLE CONDUIT & CABLE CO., INC.
New Brunswick, New Jersey

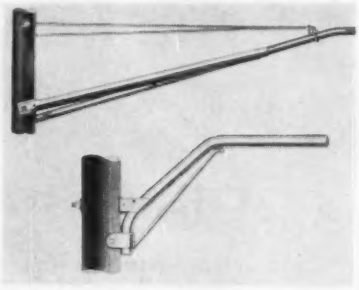
Write for bulletin describing each type. Ask for Bulletin CC10-A

Buy Smart — Buy from Your Distributor

Ground Detector

(*Continued from page* 154)

at 110 v. Transformers are included to operate it off the power line.
Principle Research and Development Co, Box 93, Franklin Park, Ill.



Street-Lighting Brackets . . .

. . . hold fluorescent luminaires with up to 8 ft of projected area steady in winds up to 100 mph. They are made of 2-in. steel pipe, reinforced. Upsweep bracket comes in 4-, 6-, and 8-ft sizes. Mast-arm bracket is available in 10-, 12-, 14-, 16-, 18-, and 20 ft sizes. There are five styles, all architecturally similar to brackets now in use.
Hubbard & Co, 6301 Butler St, Pittsburgh 1, Pa.

More New Products

Air-depolarized signal cell is rated 750 amp-hr, 975 w-hr, is no larger than conventional cells of smaller capacity. CG-750 also has improved low temperature qualities.—National Carbon Co, 30 East 42nd St, New York 17, N. Y.

"BA" standard duty **push-button stations** feature base-mounted control mechanism and front-accessible wiring terminals. Available for ac or dc voltages up to 600 v.—Furnas Electric Co, 1026 McKee St, Batavia, Ill.

Phenolic **plastic wiring raceway** will not support combustion, does not warp or sag under high temperatures.—Stahlin Brothers, Inc, 336 Maple St, Belding, Mich.

"Cushion Grip" **screwdrivers** have shockproof, neoprene rubber grip unaffected by water, oil, or gasoline. Available in 16 sizes from 3 in. to 12 in.—Bridgeport Hardware Mfg Corp, Bridgeport, Conn.

Shearing blade is removable in a new long-nose, shear-cutting **plier.** Plier has self-opening coil spring and 1/16-in.-diameter point.—Mathias Klein & Sons, 7200 McCormick Rd, Chicago 45, Ill.

Two **Epoxy-saturated insulations** for class B applications have purified asbestos base. Type 71, 45-50% resin, has dielectric strength of over 700 v per mil, high tensile strength, and moisture absorption factor (24 hr) of less than 2%. It comes in 4 or 5-mil thicknesses. Type 72 is 20-30% resin, comes 3, 4, 6, or 9 mils thick. Both types are available as tape, cut sheets, or rolls up to 36 in. wide.—Johns-Manville Corp, 22 East 40th St, New York, N. Y.

Self-contained, **closed-circuit TV camera** weighs 12 lb, can be operated remotely up to 1 mi.—General Precision Laboratory, Inc, Pleasantville, N. Y.

Fan & limit switch for gas-or oil-fired domestic heating systems is 50% smaller than previous models.

Time meters use automobile odometer for easy reading. Odometer shows six digits, measures down to 1/10 hour or minute.

Sensitive general purpose **recorder** measures and records dc signals as low as 1 mv full-scale. Dc amplifier and power supply are housed in recorder case.

"Slim" **shaded-pole motor** for blowers, cooling fans, evaporative coolers, and air conditioners comes in ratings from 35 mhp to 1/10 hp, 4 and 6-pole sizes. It is light, and has up to three speeds in either direction.

Compact **magnetic motor starter** is 42% smaller than previous open forms. Size 0 is rated up to 5 hp, 440 v; size 1:10 hp, 440 v.

Two **time switches** feature 24-hr dial capable of handling 12 on-off operations in a day with trippers set 1 hr apart. Indoor model can take 350-amp inrush current.—General Electric Co, Schenectady 5, N. Y.

BUY
ALL TRIANGLE PRODUCTS
LOCALLY FROM YOUR
ELECTRICAL DISTRIBUTOR
It's smart today to buy all your electrical needs — wire, conduit, cable, switches, fittings — from your nearby distributor. One call shopping saves you time and money.
Your distributor's warehousing saves you countless cubic feet of valuable floor space, and assures you of a constant flow of fresh materials as your schedules demand.
Your distributor gives you
Fast delivery . . . on one item or a hundred— from one manufacturer, or from many.
Simplified bookkeeping . . . one invoice, one statement, one account.
Low inventory cost . . . his stock is your inventory control, gives you working capital.
Lower insurance rates . . . less inventory means your flood, fire rates are lessened.
That's why dependable electrical manufacturers advise you to always buy from YOUR DISTRIBUTOR — THE BEST FRIEND YOUR BUSINESS CAN HAVE! He's the one source for everything electrical — and he's local.
Your Distributor— The Best Friend Your Business Can Have!
TRIANGLE CONDUIT & CABLE CO., INC.
New Brunswick, N.J.
TRIANGLE
"It MUST Be Right"

Exclusive quiet, level-ride cab

One of 9 reasons why you'll find International Trucks cost least to own!

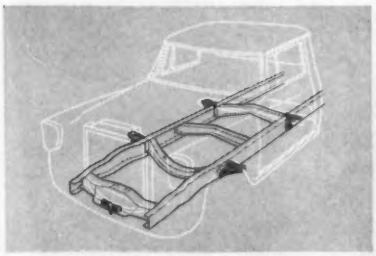
INTERNATIONAL cabs give you the smoothest, quietest and most level ride you can get in any truck! Longer life, too, with 5-point cab mountings that eliminate transmission of destructive stresses and strains to the cab and other sheet metal.

You get greater safety, convenience and comfort. For example—new Golden Anniversary models have the widest seats, roomiest cabs and biggest windshields in their class.

And more savings are yours because INTERNATIONAL Trucks cost *least* to own over the years. This has been proved* by economy-minded fleet operators from coast to coast. Why not take your cue from the men who know truck costs to the penny? Make your next truck an INTERNATIONAL.

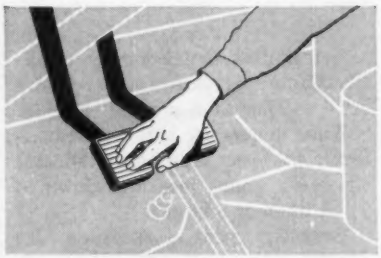
**Signed statements in our files, from fleet operators throughout the U.S., back up this statement.*

INTERNATIONAL HARVESTER COMPANY, CHICAGO
Motor Trucks • Crawler Tractors
Construction Equipment • McCormick® Farm Equipment and Farmall® Tractors

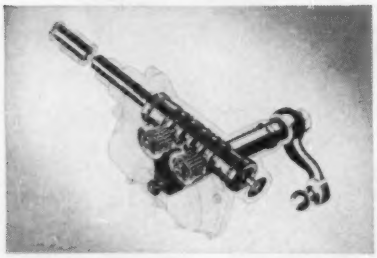


1 Greater cab comfort and longer life. Quiet, level ride without transmitting stress to cab, fenders, hood or radiator. It's the result of wide spaced, rear-shackled type cab mounting plus INTERNATIONAL 5-point rubber-insulated suspension.

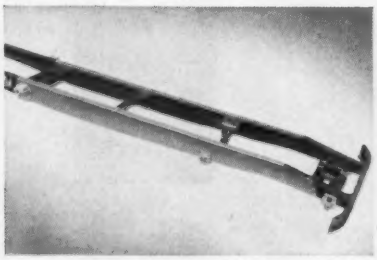
2 Extra convenience and safety. Full sweep-around windshield without projecting into door openings (see arrow). Easy, convenient entry and exit. No dangerous distortion. Corner posts are the narrowest in the automotive industry.



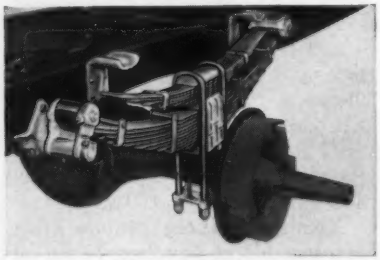
3 25% less pedal pressure to make driving an INTERNATIONAL Truck a lot easier. Exclusive clutch design with roller-mounted release fingers. Engagement is smoother. Big lining area and minimum linkage save maintenance time and cost.



4 True geometric steering with cam and roller-mounted twin lever gears on every model. Controls are mounted forward of the front axle for safer, easier handling and greater maneuverability. Factory-installed power steering optional.

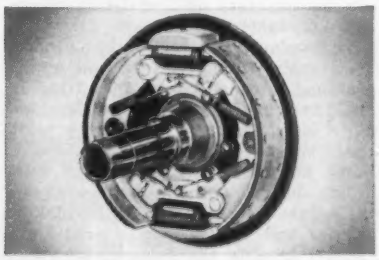


5 INTERNATIONAL frames are strong and durable with deep channel side rails and sturdy crossmembers. Non-crystallizing, cold squeezed rivets are used for extra strength and life. Inverted L-type reinforcements provide full-load support.

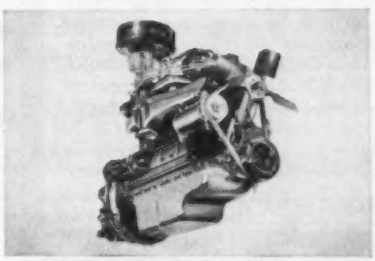


6 Wide, long and strong springs cushion the load and driver against jarring road shocks . . . provide better load support and longer life. Rear-shackled front springs increase stability and life. Shock absorbers available on most models.

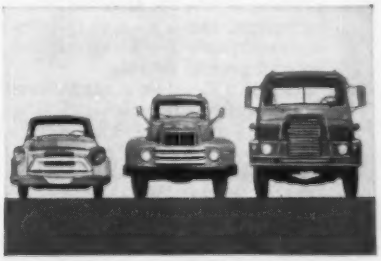
One of the new Action-Styled Golden Anniversary INTERNATIONAL Trucks with more powerful engines in every model. You get lively performance, greater economy and traditional INTERNATIONAL dependability. Safer, more comfortable driving and easier riding, too. This is a typical example of the 41 conventional, 4-wheel trucks offered in the 9,000 to 30,000 lbs. GVW range. Complete selection of equipment available to fit every job requirement.



7 Safer, longer lasting brakes on all new A-Line models. Easy-to-service, underhood master cylinder. Larger boosters, bigger wheel cylinders or increased lining area for easier braking and longer life. Air brakes standard on larger models.



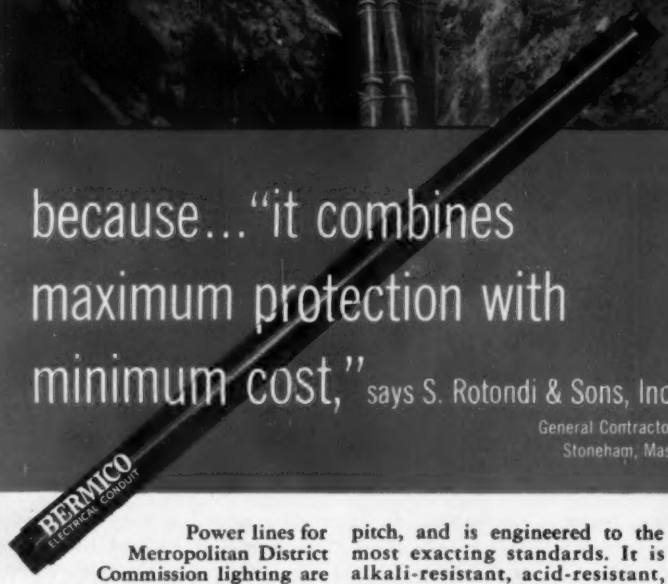
8 More usable power and greater economy. Increased performance and efficiency with new economy-proved engines in every new Golden Anniversary model. Other dependable power plants include V-8's, sixes and diesels—up to 257 hp.



9 World's most complete line. There is an INTERNATIONAL "tailor-made" for every job, half-tonners to 96,000 pounders. Choice of 4-wheel, 6-wheel and all-wheel-drive models, conventional and COE design. Every one built to cost *least* to own.

BERMICO® electrical conduit used in new Boston parkway system

because..."it combines maximum protection with minimum cost," says S. Rotondi & Sons, Inc., General Contractors Stoneham, Mass.



Power lines for Metropolitan District Commission lighting are encased in Bermico Conduit.

The installation, shown above, is along Route 28, Medford, Massachusetts, and is part of the new metropolitan parkway system around greater Boston.

Bermico Conduit is made from cellulose fibre impregnated with pitch, and is engineered to the most exacting standards. It is alkali-resistant, acid-resistant, light, strong, uniform, and is installed quickly and easily. Bermico Conduit is specified by public utilities and by consulting engineers from coast to coast. For speedier cable installation specify Bermico Conduit. Immediate shipment of all sizes and fittings guaranteed.

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BOOKS

Telephone Transmission

The Theory of Networks in Electrical Communications and Other Fields. **By F. E. Rogers. Published by MacDonald and Co Ltd, 16 Maddon St, W1, London, England. 560 pages, illustrated. Price 65s net.**

This book offers a comprehensive coverage of network and transmission line theory as it relates to the field of communications. The author traces his subject from its inception in the early work of Heaviside to modern day thinking.

Mathematics, of course, is the key to a thorough understanding of the book. The Fourier Integral is used but the Laplace Transform is not, despite the author's acknowledgment that this is an important modern approach. Space limitations of the text is cited as the reason for its omission.

Among the topics included are: multi-mesh networks, impedance matching, 2-terminal and 4-terminal networks, transmission parameters, and filter networks.

Perhaps the outstanding feature of the author's approach is the thoroughness with which he handles his mathematical derivations. He includes each step of these derivations and does not leave the reader wondering how he arrived at his final mathematical formula—which is quite often the case in mathematical texts.

Electronic Circuitry

Vacuum-Tube Circuits and Transistors. **By L. B. Arguimbau and R. B. Adler. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 646 pages, illustrated. Price $10.25.**

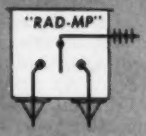
This is an extension of Arguimbau's book entitled *Vacuum-Tube Circuits.* This new work includes up-to-date material on transistors, frequency modulation, inverse feedback, and noise. The material on transistors was supplied by Adler.

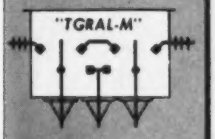
The authors have used analytical methods in their presentation and have stressed circuitry rather than physics. An exception to this is made in the chapters on transistors. Here the fundamental physical principles are developed because of the newness of transistors and their circuit applications. Formalized mathematics is held to a minimum. The text develops in a logical manner but for the most part the chapters are self-contained. This should enable the reader with some background in electronics to skip the elementary material on diodes and triodes and proceed to a higher level in the book.

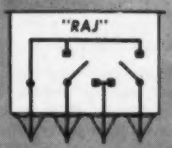
In addition to the subjects indicated above, the book presents material on: pentodes, linear, power, and tuned amplifiers, amplitude modulation, oscillators, television, and transit time.

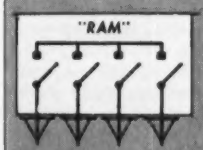
(*Continued on page* 164)

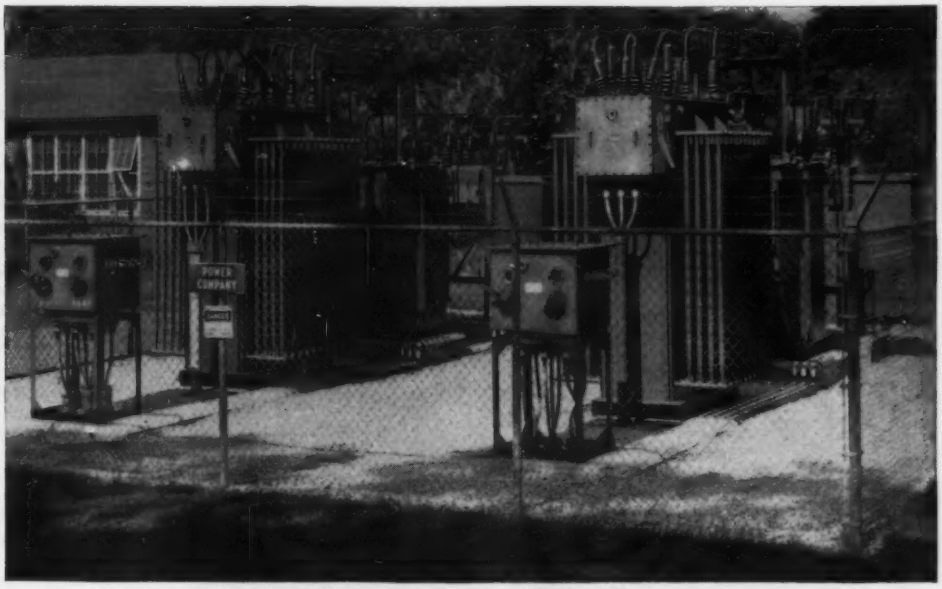
TYPE "RA" OIL SWITCHES ARE MADE IN VARIOUS FORMS TO MEET INDIVIDUAL REQUIREMENTS.









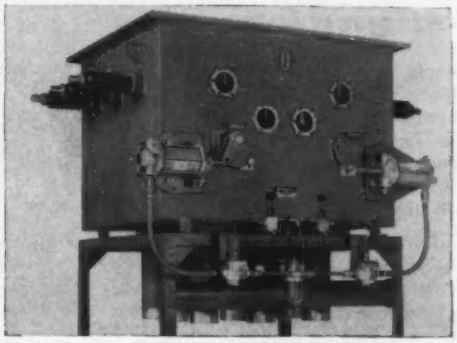


GET SAFE SYSTEM F-L-E-X-I-B-I-L-I-T-Y

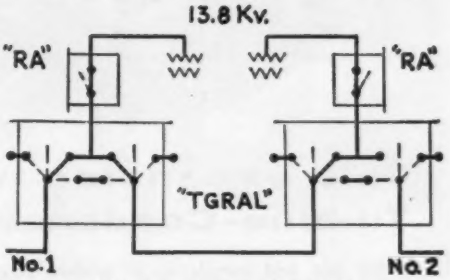
AT A LOWER COST IN YOUR DISTRIBUTION SUBSTATIONS

BY USING G & W "RA" LOAD BREAK OIL SWITCHES FOR PRIMARY SECTIONALIZING AT VOLTAGES UP TO 34,500.

Neat functional arrangements of standard equipment are being used regularly to affect appreciable savings in maintenance as well as first cost.



FULL 400 AMPERE LOAD BREAK AT 34.5 Kv.



Referring to the above illustration and diagram, feeders 1 and 2 are looped through and tapped in the two "TGRAL" load break oil switches. Each feeder can supply one transformer independently or both transformers together. Single throw "RA" oil switches mounted on the transformers provide load break isolation of the tap cables. Outlets on two sides of "TGRAL" oil switches permit testing and grounding the feeder cables. The position of the switching links can be seen through the windows in the switch tanks.

Manually controlled pneumatic mechanism is standard for 34.5 Kv oil switches and optional for remote manual operation of lower voltage "RA" oil switches.

Send for series "D" bulletins.

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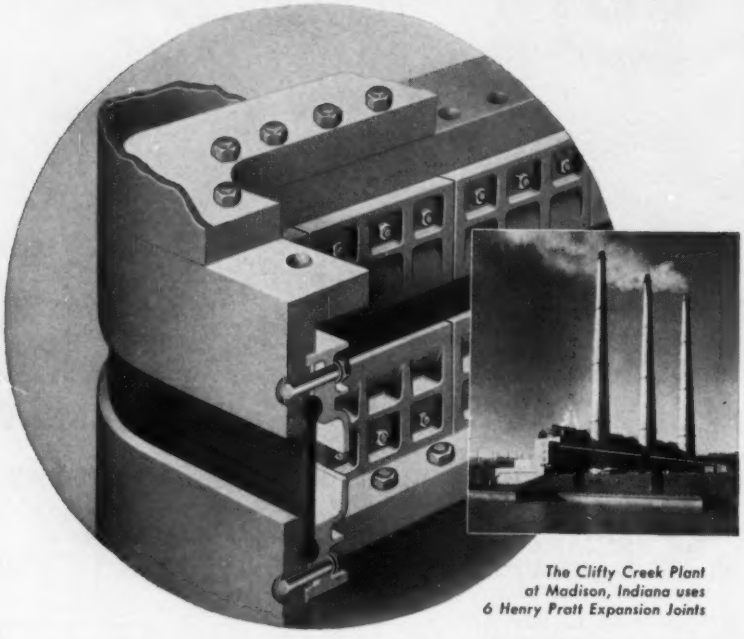
High Voltage Cable Terminating, Sectionalizing, Protecting, and Connecting Devices

POTHEADS • BOXES • OIL FUSE CUTOUTS • LOAD BREAK OIL SWITCHES • SPLICING KITS

Pratt takes the pressure off a hot problem!



The Clifty Creek Plant at Madison, Indiana uses 6 Henry Pratt Expansion Joints

This expansion joint insures Turbine-Condenser alignment

The size and complexity of modern power plants have made it very difficult to foresee all the problems involved in mounting condensers and turbines. Often the final piping engineering is not completed until after the units are installed. By using a rubber belt expansion joint between the turbine and condenser, both the engineering and the construction are greatly simplified. Construction tolerance can be held to reasonably obtainable values because the expansion joint will absorb up to one inch of axial and one-half inch of lateral movement.

Any shape or size . . . Round or rectangular shapes can be built without size limitation . . . if one dimension is less than 14'9" the joint can be shipped fully assembled, a great convenience to installation. Connections for welding, bolting or combinations such as landing bar and weld can be supplied as needed.

The Henry Pratt Company offers complete engineering and manufacturing facilities for exhaust stacks and joints, flues, ducts, butterfly valves and other power plant equipment.

Write for this detailed folder, discusses Turbine-Condenser connection methods as well as detailing the Henry Pratt Expansion Joint
Ask for Bulletin – B-2P

HENRY
PRATT

TURBINE-CONDENSER
Expansion Joints

Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill.

Books

(*Continued from page* 162)

Introduction to Circuits

Principles of Electric and Magnetic Circuits. **By Warren B. Boast. Published by Harper & Brothers, 49 E. 33rd St, New York 16, N. Y. 369 pages, illustrated. Price, $5.50.**

A second edition, this text offers an adequate basic treatment of electric and magnetic circuits. New material in this revision deals mainly with solar energy and network analysis.

The book presents a systematic treatment of circuits, with extensive examples and problems. The many excellent photographs and drawings, the most striking aspect of this volume, are an effective graphical aid in covering the subject.

This text would be useful to an electric utility conducting a basic course in circuits for high school graduates.

A Physicist's Approach

Introduction to Electrical Applied Physics. **By N. F. Astbury. Published by Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y. 241 pages, illustrated. Price $10.00.**

This book is a highly detailed physicist's approach to the fundamental principles of electricity and magnetism. It centers around four subjects: the electric field, the magnetic field, the electric circuit, and the magnetic circuit.

The subjects are treated in a rigid mathematical fashion. So that a knowledge of mathematics including vector analysis, calculus, and differential equations is a prerequisite for understanding of the book.

The book should have its greatest appeal for senior university students majoring in physics or electrical engineering.

Primer On a Modern Plastic

Epoxy Resins, Their Applications and Technology. **By H. Lee and K. Neville. Published by McGraw-Hill Book Co, 330 W 42 St, New York 36, N. Y. 305 pages, illustrated. Price $8.00.**

This is a comprehensive but lucid introduction to the new chemical field of epoxy resins—the newest and perhaps most versatile of the modern plastics. The book covers their preparation and applications in industry.

The format of the book, and the plain, clear style of the authors makes this a very readable book.

It is written for the chemist or chemical engineer but electrical engineers interested in the manufacture or use of electrical equipment may find this book of value because of the references made to the use of epoxy resins as insulating material. However these references do not constitute the major part of the book.

Science in Engineering

The Science of Engineering Materials. Edited by J. E. Goldman. Published by John Wiley & Sons, Inc, 440 Fourth Ave., New York 16, N. Y. 528 pages, illustrated. Price $12.00.

A series of lectures on the impact of solid-state science on engineering materials is the basis for this book. The lectures and the book were intended to spur educators to incorporate formal course work in modern physics and solid-state theory into undergraduate engineering curricula. The lectures see the progress of engineering beoming increasingly interwoven with solid-state science—broadly, the explanation of physical properties of solids in terms of their atomic and electronic structure.

An engineer would find this book useful as a guide to the solid-state sciences. It offers adequate and interesting coverage of the structure of matter, metals and alloys, surfaces, magnetism and magnetic properties, semiconductors and dielectrics, and non-crystalline materials.

Solving Electricity's Math

Basic Mathematics for Electricity, Radio, and Television. By Bertrand B. Singer. Published by McGraw-Hill Book Co, Inc, 330 W 42nd St, New York 36, N. Y. 513 pages, illustrated. Price, $7.50.

Basic circuits and their mathematics are given a thorough treatment in this easy-to-understand book. It builds up the mathematical principles encountered in study of electricity in slow simple stages and applies them to practical problems of electrical installation and radio and TV work.

A wealth of examples, problems, and illustrations is combined with the author's elementary approach to produce a well-organized self-study book. The basic principles are presented in such a simple and painstaking manner that this book would be well within the grasp of a good high-school student.

The beginner would find this book quite valuable for self-study or classroom use.

Books Received Since July 26, 1957

A Management Guide to Electronic Computers. By William D. Bell. Published by McGraw-Hill Book Co., 330 West 42nd Street, New York 36, N. Y. 391 pages, illustrated. Price $6.50.

Heat and Thermodynamics. By Mark W. Zemansky. Published by McGraw-Hill Book Co., 330 West 42nd Street, New York 36, N. Y. 476 pages, illustrated. Price $7.50.

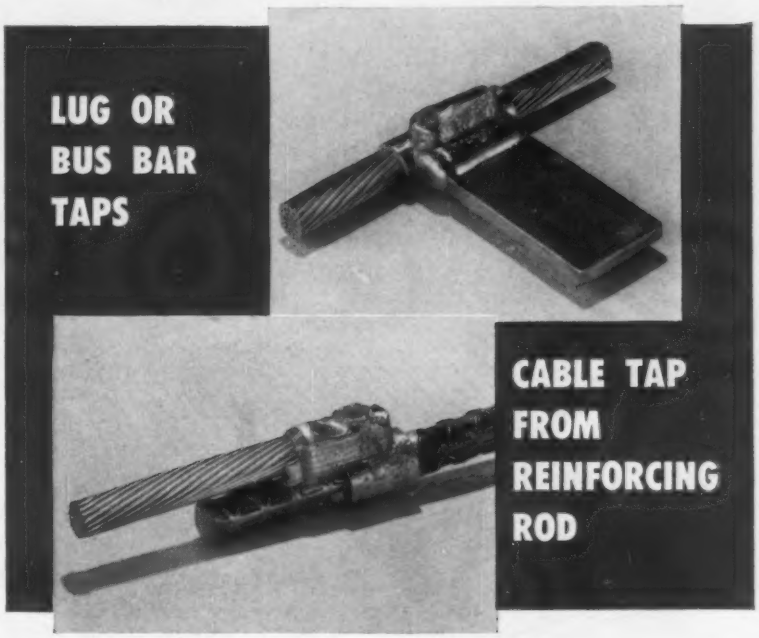
Guide to Atomic Energy Literature for the Civilian Application Program. By U. S. Atomic Energy Commission. 74 pages.

Welding Handbook, Fourth Edition. Published by Welding Society, 33 West 39th Street, New York 18, N. Y. 570 pages. Price $9.00.

CABLE TAPS

with CADWELD® connections

—most versatile



CADWELD ELECTRICAL TAP CONNECTIONS can be made from: single or multiple cables, ground rod, reinforcing rod, bus bar or tubular bus.

Whenever or wherever a tap connection is required, CADWELD gives you a permanent 100% electrically efficient connection.

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NOW···GLOBE OFFERS···
two new INTERCHANGEABLE trays for support of cables, wiring and tubing

★ Engineered for uniform design and easy installation
★ Steel or aluminum construction
★ Complete accessories for SPEEDIER Installation
★ No sharp edges to damage cables
★ Complete interchangeability

Now, for the first time, two types of cable trays, one a ladder type and the other a basket type, are available to be used INTERCHANGEABLY at any given location, depending on the type and weight of the cables to be suspended. The advantages of each type tray can thus be used to the fullest extent. Globetray, the ladder type, is intended for use where festooning is not a problem, while Cable-Strut, the basket type, is intended for the support of communication wire, instrument tubing and control cables in automation applications.

These two cable trays have been thoroughly field tested in hundreds of large industrial installations, in new plant construction, in power plants, in modernization, and for power distribution in all types of manufacturing processes. A new catalog, just off the press, gives full information and installation techniques. Ask for your FREE copy today.

Distributors are to be found in all principal cities— consult the yellow pages in your phone book under "Gratings" or "Conduits" for the one nearest you.

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PRODUCTS DIVISION

The **GLOBE** *Company* MANUFACTURERS SINCE 1914

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TECHNICAL LITERATURE

ATOM SMASHER—Mark 1-F4 linear electron accelerator with an electron beam from 2 to 10 Mev is offered for sale or leasing to laboratories. Complete description and technical data of this machine designed for nuclear and solid state physics research is offered in a brochure by Applied Radiation Corp, Walnut Creek, Calif.

ELECTRONIC COMPUTERS are clarified in an illustrated booklet of 36-pages, "How the Computing System Works for You", published by Remington Rand Univac Division of Sperry Rand Corp, 315 Fourth Ave, New York, 10, N. Y. First part of the booklet takes a tour of the Univac Electronic Computing Center while other chapters deal with circuitry. language, and coding.

HEAT PUMP—Use of a basic equation to obtain the appropriate length and configuration of a buried heat pump installation employing the earth as a heat pump and sink is the subject of Bulletin 139 of the Texas Engineering Experiment Station, College Station, Texas. "The Design of a Heat Pump Buried Coil" by D. M. Vestal, Jr, and B. J. Fluker can be obtained from the above address at $2.00 per copy.

TRANSFORMER CONNECTORS—Various types of internal connectors used in modern distribution transformers are described in Vol 1 of Kulhman Kurrents. High and low voltage external connectors and theory of inherent resilience in connectors can be found in Vol 2. Free copies may be obtained from Kulhman Electric Co, P. O. Box 288, Birmingham, Mich.

CATALOGS—BULLETINS

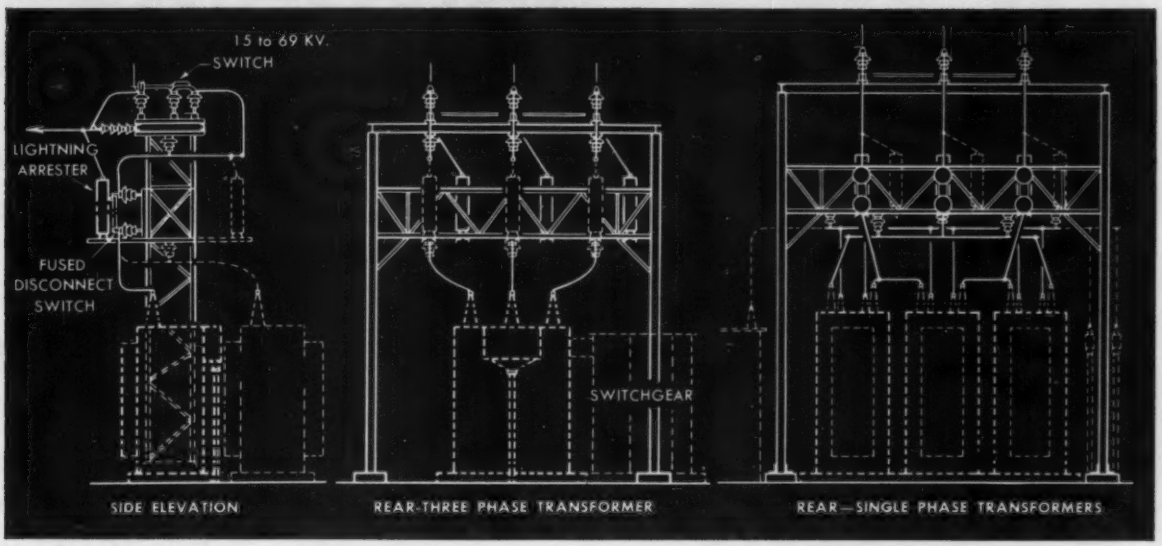
• **WIND RECORDING:** Accuracy, sensitivity, and specifications of a wind speed and direction recording system for use on standard power lines is the topic of Form F-457 issued by Beckman & Whitley, Inc, San Carlos, Calif.

• **ILLUMINATED CEILINGS:** Luminous elements and Luma Ceiling along with lighting tables and formulas can be found in "Extended Area Lighting" distributed by Pittsburgh Reflector Co, 408 Oliver Bldg, Pittsburgh 22, Pa.

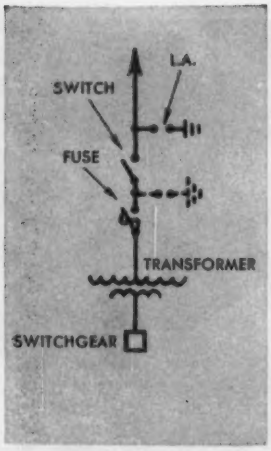
MOUNTED BEARINGS: Additions to Dodge Mfg Corp line of mounted bearings Spher-Align Pillow Blocks are described in an eight-page bulletin A-668 Write the company, Mishawaka, Ind.

(*More Catalogs on page* 170)

R&IE STANDARD SUBSTATIONS



Standardized Structures Save Your Engineering Manpower



Single-line diagram of step-down structure for 15 to 69 Kv. Several arrangements and options available.

ORDERING EASIER • DELIVERY QUICKER • ERECTION SIMPLER

ATTENTION—Industrial Power Engineers, Consulting Engineers, Power Company Industrial Sales Representatives and Contractors:

When you have need for a transformer structure for high voltage industrial application, here's the quickest and easiest way to get one. Specify an R&IE Standard "SD" Substation.

Six definite advantages are:—

1. Simplified Ordering—minimize listing and checking of miscellaneous items, often more detailed than necessary.
2. Quick Delivery—eliminate design engineering time. Parts and assemblies are standardized for fast service.
3. Simple Erection—parts and components coded and marked for positive identification and fast erection.
4. Lower Costs—accumulated savings in engineering, production and erection time, add up to lower costs for your substation.
5. Selection of Switches—include vertical break, side break and tilting insulator types.
6. Experience—over forty years designing and detailing every type of structure provides know-how for standardization.

Standard structures by R&IE can help supply industrial power easier, get power revenues quicker.

R&IE EQUIPMENT DIVISION
I-T-E CIRCUIT BREAKER CO. GREENSBURG, PA.

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R&IE

SANGAMO CAPACITORS

Sangamo's power capacitor engineering is more than skin deep. It's so complete and thorough that all designs have assured factors of safety to meet every operating condition. Insurance that Sangamo power capacitors will give better performance—longer life.

Extensive high voltage test facilities enable establishment of better than usual 60 cycle withstand and impulse voltage levels. Fully instrumented, precise powered heat run tests give the facts for optimum design with low operating temperature—and continuing life tests under actual operating conditions provide the final criterion for well-balanced liberal design.

High-voltage test berth includes equipment for 60 cycle withstand tests, impulse tests and corona measurement.

...long life assured

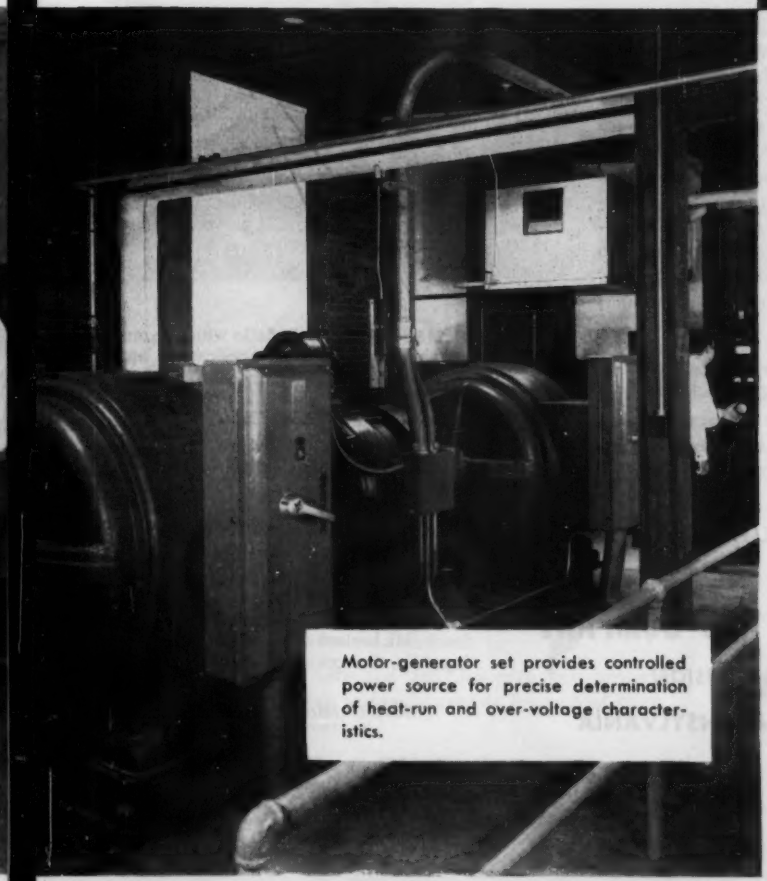
These test facilities, combined with Sangamo's many other facilities and advanced manufacturing methods, give you full assurance that Sangamo power capacitors will be your best buy.

Fine engineering and manufacturing facilities are among the reasons why inspection of Sangamo manufacturing operations by power engineers from a large number of the country's major utilities has resulted in unqualified product approval. Why many have said "This is the best capacitor operation I have ever seen."

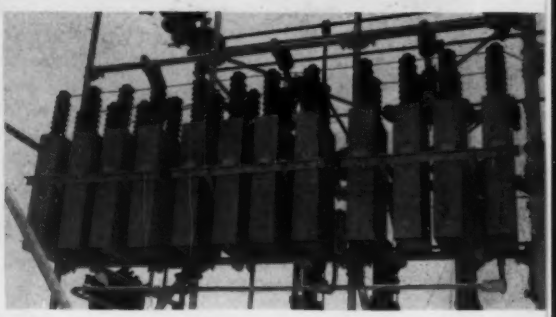
SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

PC57-4

Special test setups duplicate service installation. Here pole-type equipment is checked for mechanical construction, electrical clearances and operating temperature characteristics.



Motor-generator set provides controlled power source for precise determination of heat-run and over-voltage characteristics.



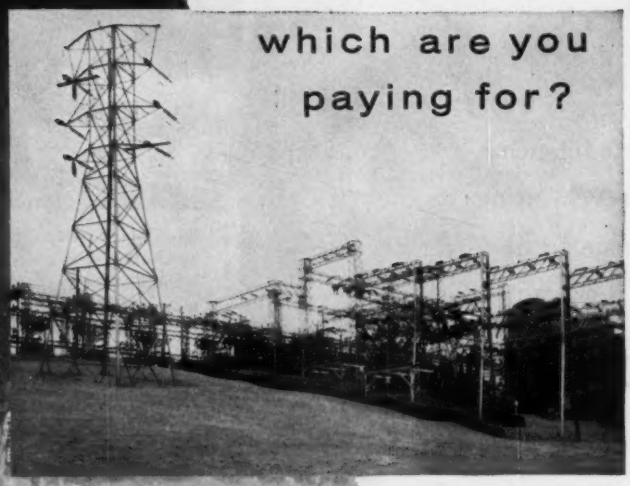
Capacitors designed for assured long life in a highly contaminated area feature stainless steel cases and specially designed "high creep" bushings.

CORROSION...

always

costs more

than **PAINT**



Corrosion always costs much more than would the necessary amount of paint to prevent it. Now, more than ever, you can realize tremendous savings in corrosion control with Sipes Tower Finish Gray No. 280, a new one-coat corrosion resistant paint for transmission towers, sub-station structural steel, woven wire fencing and other similar exterior metal surfaces. Tower Finish Gray No. 280 is a full-bodied, rust-resisting coating formulated specifically to render long and durable performance at little more than half the cost of comparable competitive finishes. Exhaustive laboratory tests and actual field tests indicate that it will out-perform competitive products costing ALMOST TWICE AS MUCH.

Eliminate your cost on corrosion — minimize your costs on its prevention. Specify Sipes Tower Finish Gray No. 280 for your next maintenance project. Compare its performance and cost with what you are using today. You'll be convinced . . . paint costs far less than corrosion.

WRITE FOR SIPES TOWER GRAY BULLETIN TG 280

SIPES
Reg. U. S. Pat. Off.

JAMES B. SIPE AND COMPANY

INDUSTRIAL DIVISION

PITTSBURGH 16, PENNSYLVANIA

Catalogs–Bulletins

(*Continued from page* 166)

• **EXPLOSION-PROOF SWITCHES:** Along with three other types of switches are subjects for data sheets 129, 131, 132, and 134 printed by Micro Switch Division, Minneapolis-Honeywell Regulator Co, Freeport, Ill.

• **REFLECTOR FLUORESCENTS:** Expanded line of reflector fluorescent lamps are summarized in a four-page folder by Sylvania Electric Products Inc, 1740 Broadway, New York 19, N. Y.

• **FLEXIBLE COUPLING:** Para-flex, flexible cushion coupling, is introduced in a 12-page bulletin of Dodge Mfg. Corp, Mishawak, Ind.

• **LOAD RECORDERS:** Bulletin describes five types of load survey recorders for surveying residential and industrial load characteristics. Write to Westinghouse Electric Corp, P.O. Box 2099, Pittsburgh 30, Pa., for bulletin 42-501.

• **RADIANT HEAT:** Applications of radiant heating equipment in metal processing are shown in booklet No. 57-108 printed by Fostoria Pressed Steel Corp, Fostoria, Ohio.

• **ALUMINUM GRATING:** Types of grating and stair treads are described in one of Klemp Metal Grating Corp's bulletins while another details its Rectangular Riveted aluminum grating. Write to the corporation at 6631 S. Melvina Ave, Chicago 38, Ill.

• **DIESELS:** Literature on its Model 65 Superior Stationary Diesel listing its specifications and applications can be obtained by requesting bulletin No. 111 from White Diesel Engine Division, White Motor Co, Springfield, Ohio.

• **LIGHTING:** Specifications for architectural lighting fixtures are included in bulletin No. S-58 which can be obtained from Gruber Bros Inc, 125 S. First Street, Brooklyn 11, N. Y.

• **PHASEMETER:** Bulletin with diagram of meter and details of applications and specifications is available from Statham Development Corp, 12411 W. Olympic Blvd, Los Angeles 64, Calif.

• **MAGNETIC DRIVES:** Notes about Ampli-Speed magnetic drives and their uses are in bulletin No. 5 by Electric Machinery Mfg Co, Minneapolis, Minn.

• **COMPANY HISTORY:** Story of development of electrical engineering firm from its start after college is available from Michaelson and Associates, 617 Laughlin, Princeton, N. J.

(*More Catalogs on page* 172)

Four Low-Cost Ways to Keep High Temperatures at Bay!

Flexible and fireproof K&M Asbestos Textiles insulate and protect wires, cables, coils and transformer leads from fire, high temperatures and chemicals.

Practically indestructible K&M Asbestos Textiles retain their electrical insulating qualities through a wide range of heat, humidity and weather changes.

High-tensile-strength K&M Asbestos Textiles reduce downtime due to technical failures.

Economical K&M Asbestos Textiles give you protection at high operating temperatures at lower cost than other insulating materials.

Write today for complete details on safe, economical K&M Asbestos Textiles.

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BEST IN ASBESTOS

KEASBEY & MATTISON
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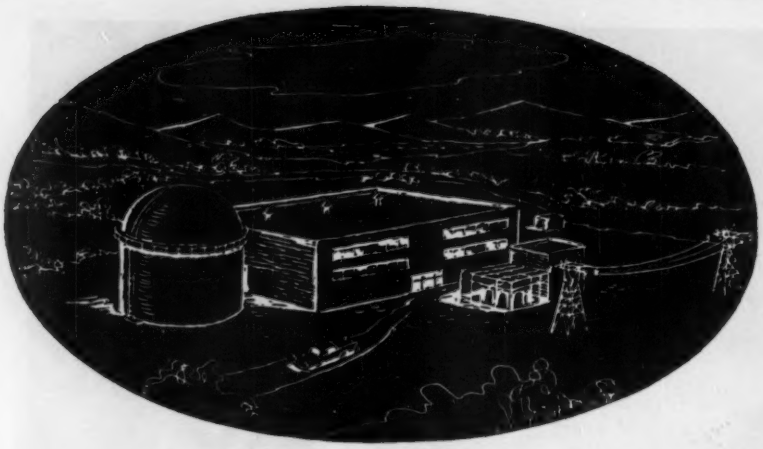
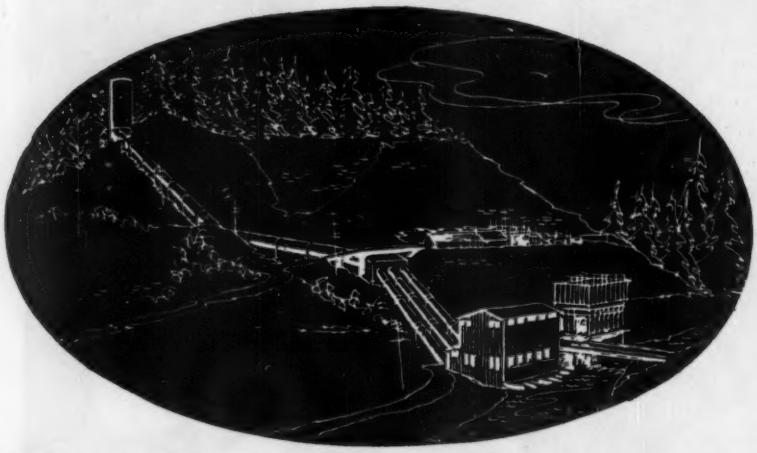
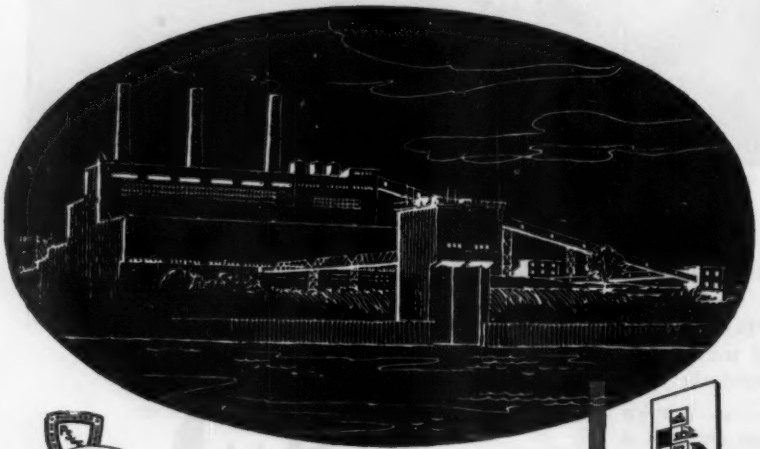


PUTTING **POWER** INTO
YOUR EXPANDING PROGRAMS



ATOMIC, HYDRO and FOSSIL FUEL POWER PLANT DESIGN
FOR INDUSTRIALS and UTILITIES



55 YEARS

Pioneer Service & Engineering Co.

231 South La Salle Street • Chicago, Illinois

Send for our descriptive booklet, "Pioneering New Horizons" of these and other services.

Catalogs–Bulletins

(*Continued from page* 170)

• **MULTIPLE SPINDLE TOOLS:** Automation in assembly through use of these tools is the subject of this booklet printed by Thor Power Tool Co, Automation Division, Prudential Plaza, Chicago 1, Ill.

• **HORIZONTAL BREAK SWITCHES:** Outdoor, group operated switches of this type for service at 7.5, 15, 23, 34.5, 46, and 69 v with a capacity of 600 amp are illustrated in Bulletin PSE4, Line Material Industries McGraw-Edison Co, Milwaukee 1, Wis.

• **AUTO-SWITCH CAPACITORS:** GEA-6543 discusses the trend towards auto-switched capacitor equipment for distribution circuits and lists those available. Write General Electric Co, Schenectady 5, N. Y.

• **SELF-PROTECTING TRANSFORMERS:** Design features are illustrated for this transformer which protects itself against lightning, overloads, and short circuits, in "ACP Transformers", 61B73-09C, Allis-Chalmers Mfg, Co, Milwaukee 1, Wis.

• **ELECTRIC PLANTS:** Variety of applications for "Vacu-Flo" cooled electric plants are covered in this 16-page booklet. Further information can be obtained from D. W. Onon & Sons Inc, Minneapolis 14, Minn.

• **GAS DETECTOR:** Portable unit for detecting and measuring natural gas concentrations is topic of bulletin from Johnson-Williams, Inc, 2738 Park Blvd, Palo Alto, Calif.

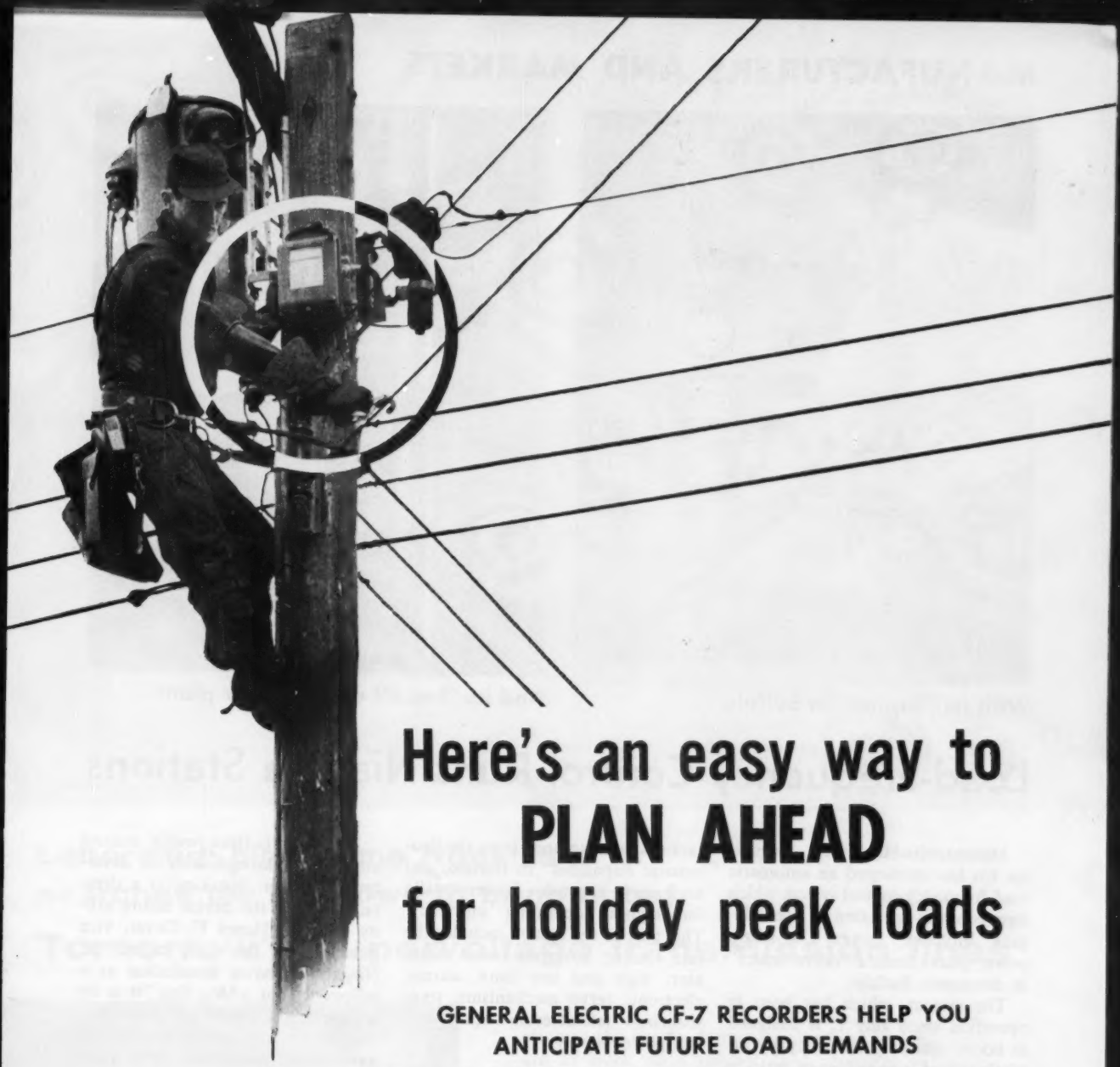
• **ELECTRIC SETS:** Caterpillar D353 and D318 engines are now available for industrial electric sets. Further information on these engines can be found in bulletins issued by Caterpillar Tractor Co, Peoria, Ill.

• **HANDLING VISCOUS FLUIDS:** Electric heater hook-ups and heat requirement nomographs for storage tanks are diagrammed in bulletin 202A issued by Hynes Electric Heating Division, Turbine Equipment Co, Mountainside, N. J.

• **PUSHBUTTON SWITCHES:** Various types of pushbutton switches are described in data sheets 110, 115, 116, 117A, 123, 124, 125, and 128 issued by Micro Switch Division of Minneapolis-Honeywell Regulator Co, Freeport, Ill.

• **EASIER CHARTING:** Catalog issued by Chart-Pac, Inc, Leeds, Mass., details its line of pressure-sensitive printed tapes, templates and other chart materials.

• **MODULAR ILLUMINATION:** Panelaire for lighting large areas is the subject of a catalog of Lighting Products, Inc, Highland Park, Ill.



Here's an easy way to PLAN AHEAD for holiday peak loads

GENERAL ELECTRIC CF-7 RECORDERS HELP YOU ANTICIPATE FUTURE LOAD DEMANDS

The versatile CF-7 hook-on recorder gives you an easy way to chart the variations of troublesome holiday peak demands, caused by maximum lighting, hot-water heater and industrial loads. These accurate records can help you plan your load distribution easily and efficiently. Result: you save money and improve customer good will.

Here's why the CF-7 Recorder gives you fast, accurate records:

Fast, Easy Installation: No cutting or splicing required when measuring current; just hook-on the Butyl-molded transformer.

Multi-range Operation: 6 Current Ratings 15/30/75/150/300/750 amps; 3 voltage ratings 150/300/750 volts.

Butyl-molded Transformer Insulated to 8700 Volts

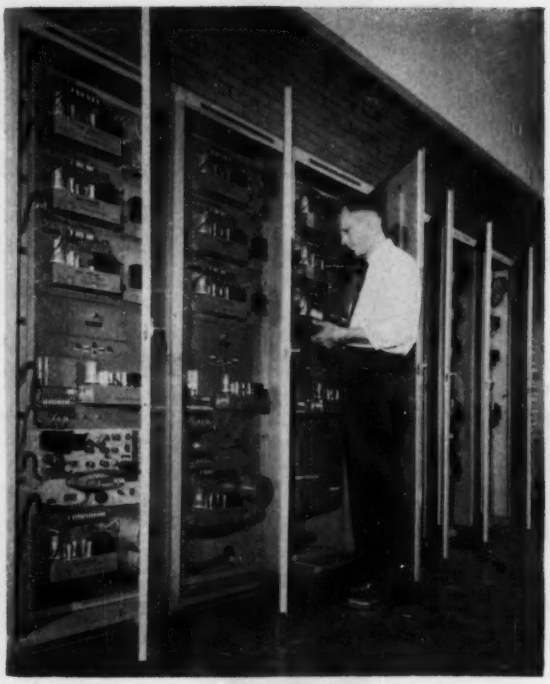
Accurate to 3% of Full Scale

Outdoor Service: Rugged, sealed case; inkless recording; 30-day continuous record without attendance.

To see how the CF-7 Recorder can help you with your load problems, contact your nearest General Electric Apparatus Sales Office or your local distributor; or, write for CF-7 bulletin GEA-6104 to: General Electric Company, Section 582-25, Schenectady 5, New York.

GENERAL ELECTRIC

With its "brains" in Buffalo . . .



And its "heart" at the power plant . . .

Load-Frequency Control Runs Niagara Stations

Minneapolis-Honeywell Regulator Co has developed an automatic load-frequency control system which now controls operation of two Niagara Mohawk Power Co steam power plants from a "nerve center" in downtown Buffalo.

The system, which has been in operation since July 1, is designed to boost operating efficiency by initiating load correction as quickly as one second after deviation.

The "brains" of the $75,000 command-type system are located in a dispatcher's office in Buffalo. Built into a console 30 in. wide are all adjustments needed to control power flow over four tie lines and to control and incrementally load Niagara Mohawk's generating stations at Tonawanda and Dunkirk, N. Y. There is space left on the console for equipment to control two more stations.

At the Huntley Station in Tonawanda and the Dunkirk Station on Lake Erie is the "heart" of the load-frequency control system. Relay racks take commands from the "automatic dispatcher" in Buffalo, and load each generator incrementally for highest operating efficiency. This part of the system includes the rate limiter, governor motor actuator, high and low limit alarms, electronic servo mechanisms, transistorized telemetering equipment, and power supply.

Controls Largest Station

At Huntley, the system is controlling Niagara Mohawk's largest station. A $60 million expansion program will increase its capacity from 774 Mw, its present rating, to 1,200 Mw by September 1958. The giant plant consumes more than two million tons of coal a year—the equivalent of a train of 50-ton gondolas 310 mi long. Huntley's efficiency is high. It produces one kw per slightly more than ¾ lb of coal.

Capacity at Dunkirk is being tripled to 612 Mw by the addition of two 200,000 kw steam-electric generating units by the end of 1959.

Minneapolis-Honeywell's control unit is not through with its development either. Speaking at a demonstration of the device before utility officials, Henry F. Dever, vice president of the firm, hailed the Niagara Mohawk installation as a milestone, but added that "it is by no means the end of our progress."

"The fund of knowledge that we have gained will enable us to push out still further the frontiers of central station instrumentation," he said. "We are hard at work to do just that."

But major strides have already been taken, Minneapolis-Honeywell feels. Among these are: Generator output control using transistors which gives accuracy within 1% through temperatures from 30F to 120F while adhering to economic curves; rate limiting based on output and independent of the control system; and accurate transistorized telemetering.

(*More M&M on page* 187)

Laboratory high in the Rockies searches the unknown to bring about

Tomorrow's supervoltage transmission lines

High in the Rocky Mountains west of Denver, men are at work on a project that promises valuable benefits to the entire electric utility industry.

There, Public Service Company of Colorado, in cooperation with Westinghouse and other company manufacturers of high-voltage equipment, has created a giant outdoor laboratory.

Their purpose: to study and measure the elusive phenomena of corona and radio influence, and establish facts upon which the supervoltage transmission lines of tomorrow can be designed.

Photo at left shows Harry Morgan, Westinghouse Sales Engineer, discussing some of the equipment under test with L. M. Robertson, Chief Electrical Engineer and sponsor of this project for Public Service Company of Colorado.

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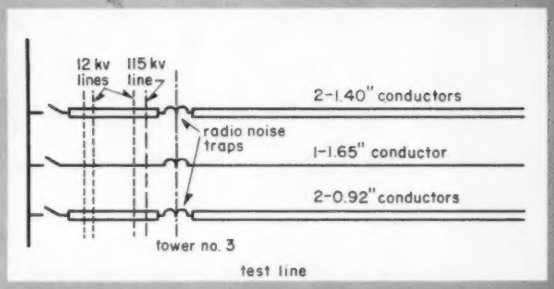
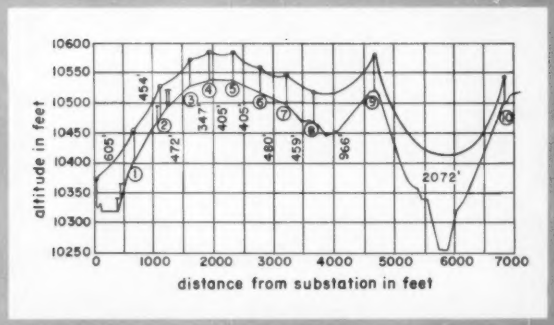
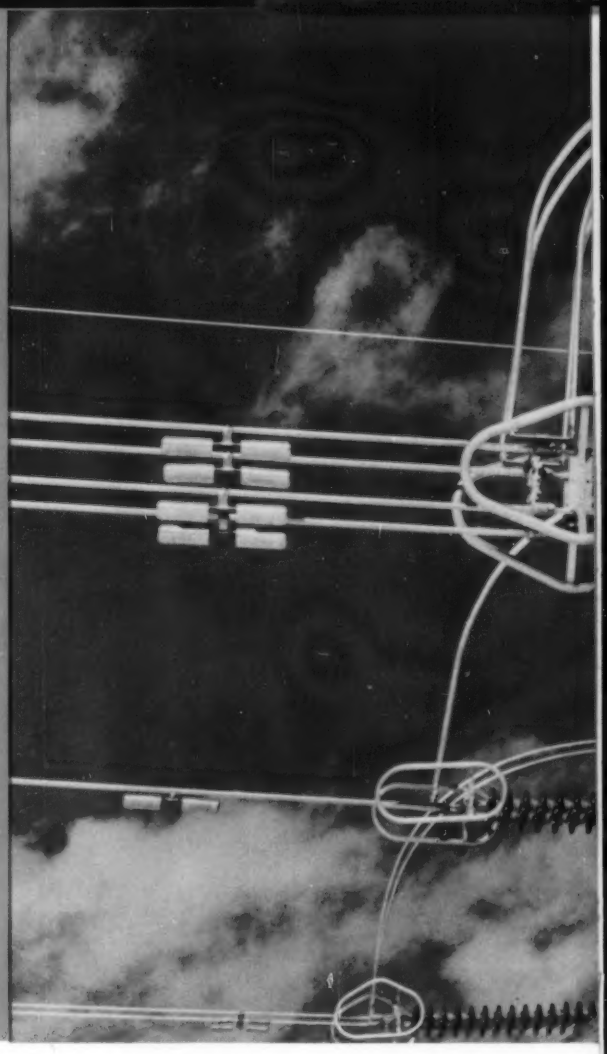


Schematic diagram of conductors as they will be tested, showing the radio noise traps at Tower No. 3 to isolate the test line from radio influence of nearby transmission lines.



Profile of the Leadville test line illustrates altitude of tests. Note foreshortening of distance from substation.

Close-up of Tower No. 3, high over Leadville. Largest conductor is the single conductor in the middle, a duplicate of Tidd conductors. The four-bundle in the foreground is medium size, later to drop to two-bundle for testing. The two-bundle conductor in the background is the smallest line size under test.



500,000-volt corona tests are now underway in the Colorado Rockies

Extra-high voltages will be required for economical transmission of the electrical industry's rapidly mounting energy requirements. Westinghouse is now prepared to supply much of the equipment required to handle these voltages. But the entire industry is aware that additional information is still needed regarding corona and the resulting energy losses, as well as the radio influence it creates at high altitudes.

The AG&E tests at Tidd Station made great strides. Additional performance data gained at Leadville, it is hoped, will make ehv practical not only system-wide, but nationwide.

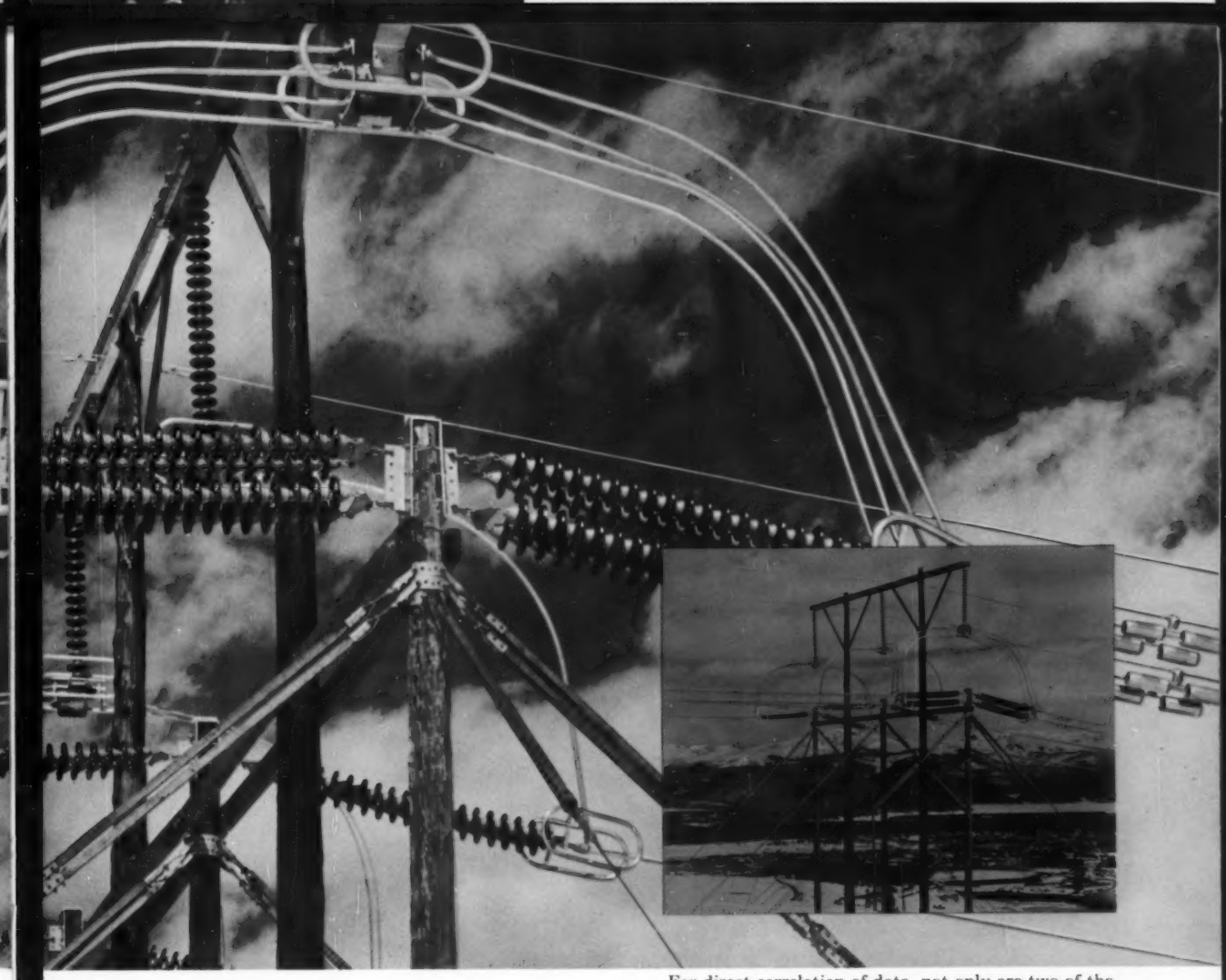
With line construction and instrument calibration now completed, Public Service Company and its collaborators are embarking on the actual tests, ranging upward from 173 to 500 kv.

Towers carry three single-phase circuits, data later to be correlated to three-phase. Circuit No. 1 bundles four 1.40″ conductors. No. 2 carries one 1.65″, and No. 3 bundles two 0.92″. All conductors except the latter are expanded ACSR.

The four-bundle circuit, having adequate conductor for zero corona at the voltages under test, served to develop reliable data for instrument calibration. On completion of calibration, this circuit will drop one line to run brief tests as a three-bundle and, finally, will drop one-third to get comparative data with two conductors.

Energy loss and radio influence will be measured under violent extremes of weather

The test site at Leadville was selected because the altitude averages 10,500′, with temperatures ranging from high 80's to 30° below. Test lines are sub-



For direct correlation of data, not only are two of the conductors designed to duplicate Tidd tests, but the Westinghouse transformer, arresters, disconnects and measuring equipment were shipped directly from Tidd to Leadville, Colorado.

ject to wind velocities, rain, snow and atmospheric conditions that would be difficult to simulate for components in a laboratory; impossible to recreate for an entire transmission line. Existing data concerning the effect of altitude (low barometric pressure) on corona are based on work with relatively small conductors in evacuated chambers.

Two-mile high Leadville tests will extend knowledge gained in Ohio Valley Tidd Project

No. 2 and No. 3 circuits at Leadville, carrying one 1.65″ conductor and two bundles of 0.92″ conductors, are designed for direct correlation with data gathered on these conductor sizes at Tidd Station. The Westinghouse substation equipment transformer, arresters and disconnects were originally furnished for the Tidd tests. At the conclusion of the Leadville test, this same equipment will be used in the AEIC high-voltage cable test program.

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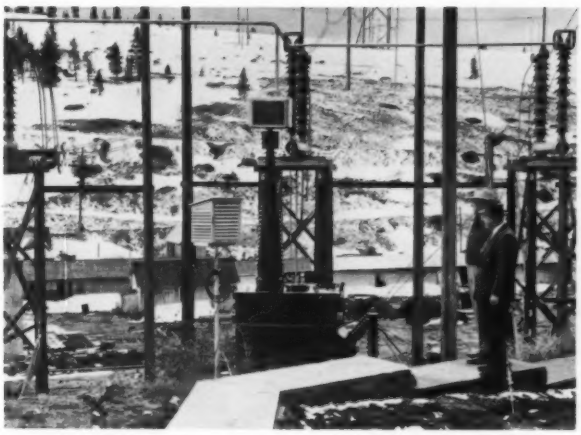
cooperates with Public Service Company of Colorado to move back transmission frontiers

Westinghouse is proud to be a member of the participating manufacturers collaborating with Public Service of Colorado. Some of the Westinghouse equipment furnished is shown here. But more important is the knowledge to be gained . . . basic knowledge for the benefit of the entire industry . . . unequalled experience in ehv equipment to influence designs of the future.

With this telescope located in the station house, Jim O'Neil takes a direct reading on the instruments on top of the transformer as a cross check on the recorder located in the "nerve center."



Harry Morgan of Westinghouse is shown with L. M. Robertson, Chief Electrical Engineer of Public Service, at the upper level of the substation. Note the instrument panel on high-voltage bushing which reports current and voltage at start of line.

LEFT: Nerve center of the "great outdoors laboratory." James O'Neil, Westinghouse Engineer, and Joseph Wissenbach, Communications Engineer for Public Service, are shown checking the charts that record: (1) conductor temperature, (2) air temperature, (3) dew point, (4) barometric pressure, (5) wind direction, (6) wind velocity, (7) line voltage, (8) line current, (9) corona loss in kw, and (10) radio influence.

RIGHT: Another of the double-check points. Jim O'Neil and Joe Wissenbach inspect the radio influence detection equipment located at the base of the main transformer.

LOWER RIGHT: Radio influence meters are located at various distances from line. To protect them against the extremes of weather, without damping their sensitivity, they are enclosed in temperature-controlled all-plastic huts.

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C. F. WAGNER,
Consulting Engineer
Engineering & Service Dept.
AIEE Fellow, CIGRE

W. E. PAKALA, *Advisory Engineer*
Research Laboratories
Member: AIEE, IRE

D. F. SHANKLE,
Engineer-in-charge
Advanced Development Group
Member: AIEE Committee on Switchgear
AIEE Standards Committee
NEMA Power & Communication Co-ordination Committee

J. K. DILLARD, *Manager*
Electric Utility Engineering
Member: AIEE Committee on Transmission and Distribution
Chairman, AIEE General Systems Subcommittee
Vice-Chairman, AIEE Committee on Power Rectifiers

T. J. BLISS, *Engineer*
Electric Utility Engineering
Associate Member: AIEE

H. S. SHOTT, *Consulting & Application Engineer*
Electric Utility Engineering
Member: AIEE

J. E. O'NEIL, *Engineer*
Advanced Development Group
Associate Member: AIEE

B. J. SPARLIN,
Laboratory Engineer
Radio Influence Laboratory
Member: AIEE

The Extra-High Voltage tests

...another example of the Westinghouse "Plow-Back" policy

It has been a consistent policy of Westinghouse for years, to invest time, talent and money in the development of new knowledge as well as new equipment for the industry. While tests continue in the High Voltage Laboratory in East Pittsburgh and in divisional laboratories throughout the company, proving out new equipment, research teams working with the nation's electric utilities explore the industry's unknowns.

The Westinghouse engineers co-operating on the Public Service of Colorado tests are shown above.

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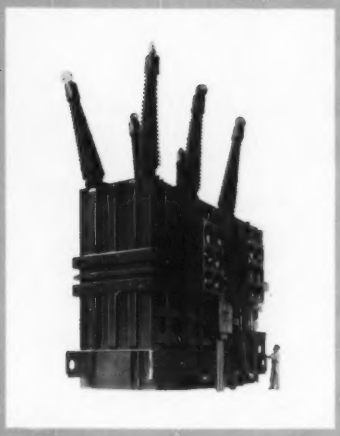
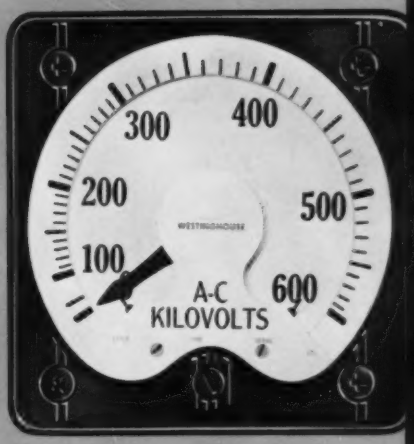
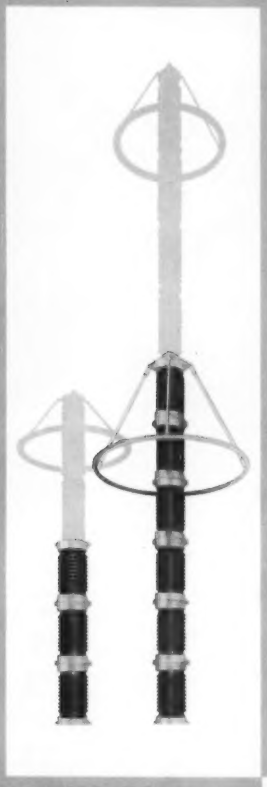


400,000-kva autotransformer

25,000,000-kva power breaker

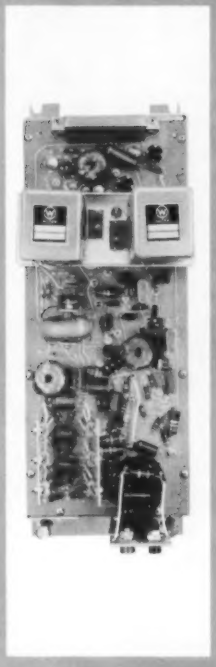


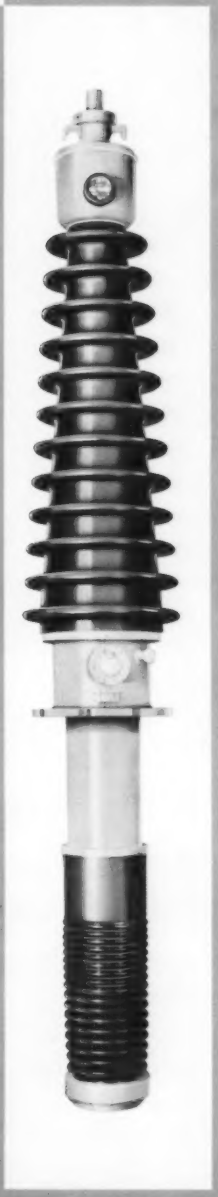
K-24 instruments—600 kv



182-kv lightning arrester

Completely transistorized carrier



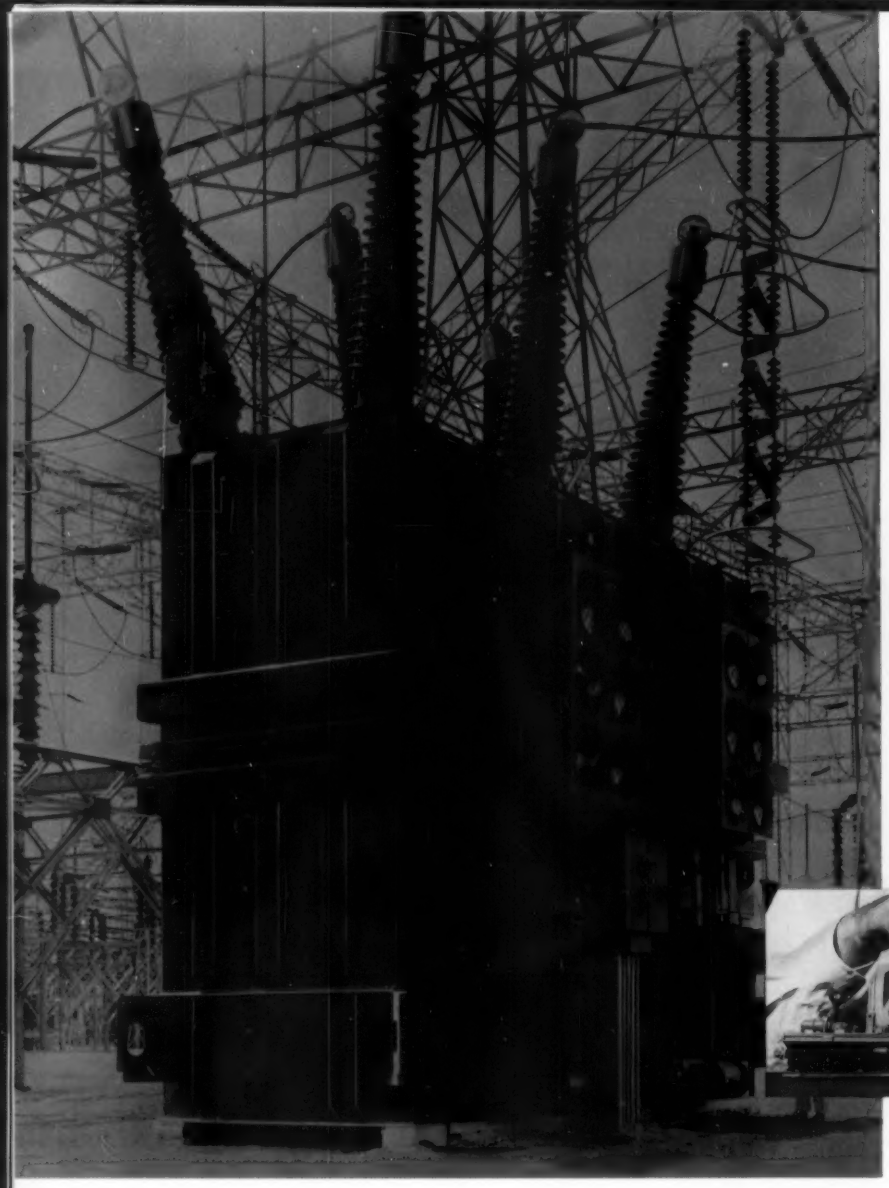


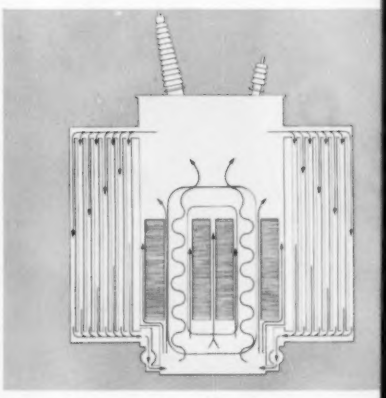
Type "O" Bushing—92-345 kv

The Westinghouse "Plow-Back" policy has already resulted in equipment now ready for supervoltage transmission

196-kv high-speed grounding switch

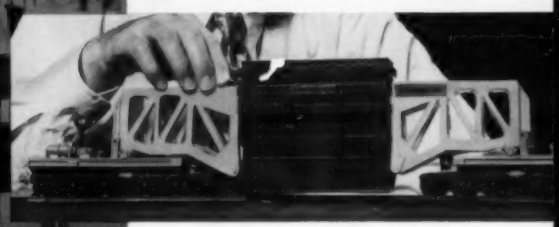
K-Dar compensated relay system





Close-fitting tank and vertical coil construction of Form-Fit transformers combine to form directed paths for coolant. Forced-oil cooling eliminates need for thermal head, provides maximum coverage of coil surfaces within minimum space.

Shell-form construction places core on the outside, coils inside for maximum mechanical strength. Solid insulation is used at high stress points; creepage surfaces eliminated.



New Westinghouse-designed transformer railroad car will permit more direct routing . . . faster delivery to help speed your construction schedules. With the transformer suspended only six inches above rails, and with a capacity of 250 tons, this car, the "Schnabel," provides additional room to grow . . . will permit transformers of the supervoltage era to be shipped in one piece.

From design to delivery...

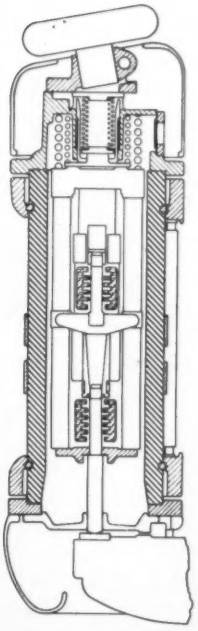
Transformers with room to grow meet the challenge of ehv* future

Extra-high voltage transmission of the future presents no problems for Westinghouse transformers. Utilizing the basic "Form-Fit"® design with forced-oil cooling, these transformers are both smaller and lighter per kva than any other design. Here is a design with room to grow . . . a principle that can be extended to any foreseeable voltage level . . . meeting the challenge of the supervoltage future.

Westinghouse can now build transformers with voltages practical for the next decade . . . voltages up to 380, 440, 500 kv or beyond.

*extra-high voltage

Westinghouse high-power laboratory made possible world's first 345-kv breaker, paved way for ehv



Developed in the Westinghouse high-power research laboratory, the tubular, multi-break interrupter made possible the world's first 330-kv, 25-million-kva circuit breaker. This development has made practical the extension of circuit breaker ratings into still higher voltages; it will pave the way for solution of problems involved in handling extra-high voltages . . . supervoltages of 500,000 and above.

ultra-high-speed reclosing can be extended to ehv breakers

Trouble-free, trip-free service is provided by pneumatic operating mechanisms in Westinghouse circuit breakers rated to 345 kv. Both mechanically and electrically trip-free, breakers trip open in standard operating time when closed on a fault. Reclosing is fast—just 15 or 20 cycles. Automatic selection of trip-free or non-trip-free operating results in ultra-high-speed reclosing for larger breakers.

These are some of the benefits you can expect to find extended into the supervoltage future.

Now in use in breakers up to 345 kv, the tubular interrupter grids also have excellent line-dropping and capacitor-switching characteristics—proved in laboratory and field tests. *Additional tests have proved the performance of this interrupter at even higher voltages.*

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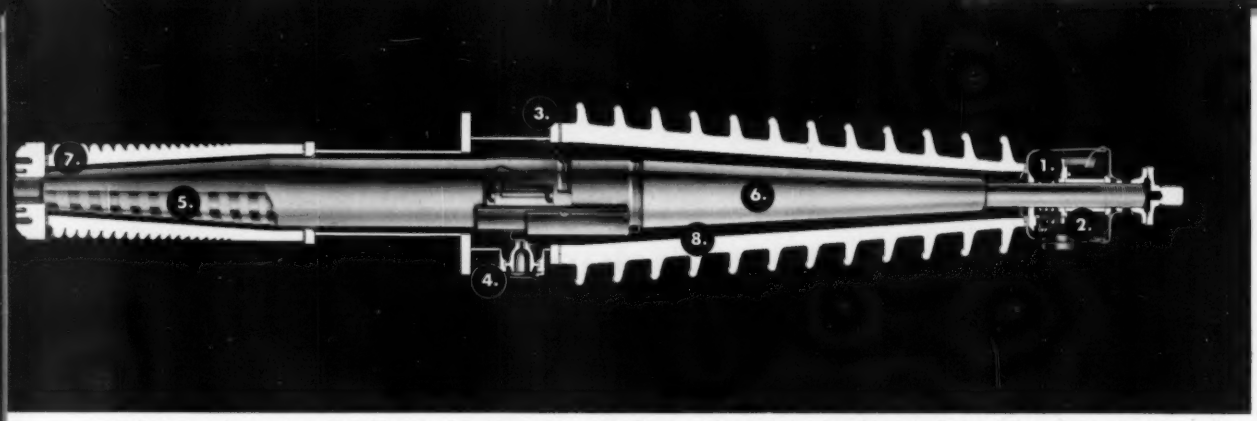


1. Compression spring assembly 2. Inert gas space 3. Concentric gasket assembly 4. Potential tap receptacle 5. Concentric foil layers 6. Oil-impregnated condenser 7. Porcelain arc shield 8. Porcelain weather casing

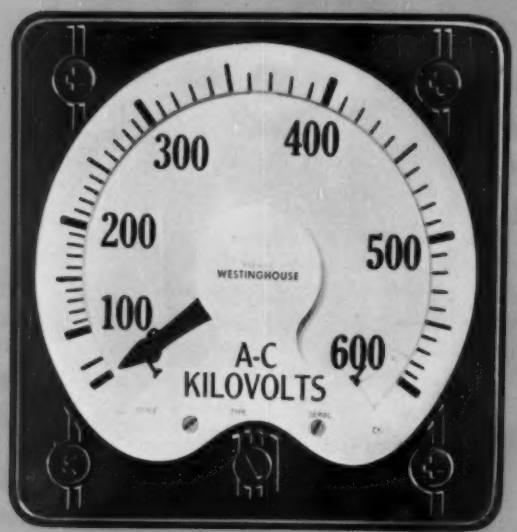
Fifty years' bushing dependability builds toward corona-free ehv

As demands on power equipment go up and up, so—ordinarily—do the problems of corona. But the Westinghouse Type "O" bushing used for breakers and transformers in the higher voltage range—92-345 kv—is far from ordinary.

The Type "O" bushing is corona-free. It has greater dielectric strength than any other bushing made; vacuum oil-impregnation of the condenser insures insulation with the highest possible strength in a minimum of space.

Westinghouse pioneered the condenser principle, has designed, built and improved condenser bushings for 50 years, building toward the era of supervoltages, building toward corona-free ehv bushings.

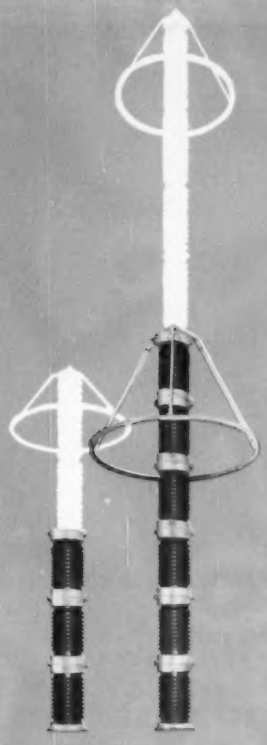
Seeing is believing with super-legible K-24 instruments



Important electrical data is gathered by accurate instrumentation . . . and costly errors must be avoided. Westinghouse K-24 circular-scale instruments—designed to help eliminate these errors—can be read at distances of 20 feet or more, at angles up to 65 degrees. Shadow-proof and glare-proof, the dials of K-24 instruments keep distortion of readings at a minimum.

The long scale, coupled with small flange area, increases readability and saves space—K-24 instruments can be grouped compactly in higher banks, do not have to be spread out at a lower level. K-24 instruments simplify one-man operation.

Accuracy for the future. This K-24 instrument dial for extra-high voltage applications provides a good demonstration of how great even the smallest error can be. Each division on the dial represents 10 kv. Excellent legibility practically eliminates chances of misreading dial.



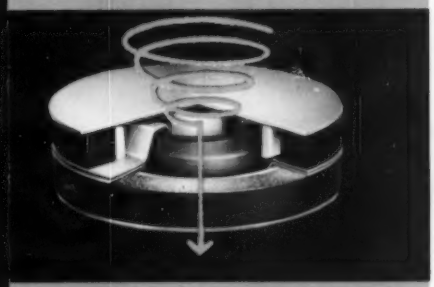
The new reduced-height type SVS arresters are self-supporting; installation is simpler—up to 300,000 pound-inch cantilever strength.

Westinghouse shrinks arresters, tailors height and performance to tomorrow's supervoltages

The constant increase in the physical size of lightning arresters resulting from ever-rising voltages could have caused a critical space problem. But Westinghouse engineering came to the rescue . . . developed an arrester design that not only reduced the height of arresters for present high-voltage ratings, but provided room to grow for the supervoltage requirements of the future. The height reduction—up to 45 percent—from this new design stems from physically paralleled elements, connected in series electrically.

At the same time, greatly increased operation due to switching surges called for a means of preventing pitting and other damage to the gap electrodes. This was achieved with development of the new Mobilarc gap, utilizing a radially polarized magnet which spins the arc around a longer path on the gap electrode surfaces. Due to the movement of the arc, the electrodes are not affected . . . maintain their original condition. Currents of 100,000 amperes have been discharged through the gaps without changing the permanent magnetic field.

These two developments have resulted in better performance packed into a smaller arrester . . . another example of Westinghouse designing for the supervoltage future.



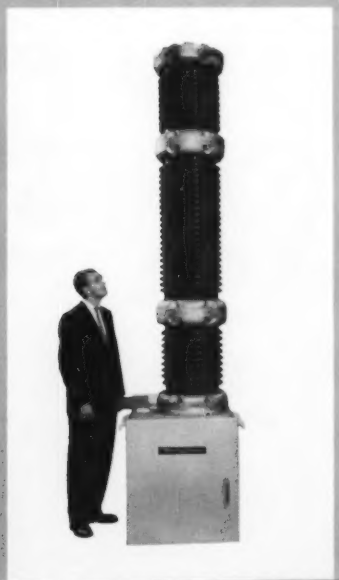
The Mobilarc gap safely spins the arc over the electrode, with no change in gap characteristics—even after 1,300 tests.

Faster, better protection for your transformers of the future

The new Westinghouse high-speed grounding switch closes in five cycles—six times the speed of conventional grounding switches. This revolutionary unit initiates a ground fault which trips remotely located circuit breakers, clearing the line before extensive transformer damage can occur. Closing time is minimized by locating the contacts relatively close together in a high-dielectric sulphur-hexafluoride (SF-6) gas atmosphere, and by providing reciprocal blade action instead of swinging action.

Contacts and mechanism are fully enclosed—impervious to weather. Speed and reliability are maintained even under conditions of severe icing and with temperatures as low as —40°F.

The grounding switch in ratings up to 196 kv is protecting today's transformers from damage. With the design principle of this switch, ratings can readily be increased as needed to afford this same protection to tomorrow's supervoltage equipment.



This 196-kv grounding switch is one of two built by Westinghouse for Pennsylvania Power & Light Company's Peckville substation. This unit is capable of closing a 20,000-ampere circuit in five cycles.

YOU CAN BE SURE...IF IT'S Westinghouse

Extra-High Voltage transmission puts new emphasis on reliable carrier communication

Accurate decisions in a utility have always depended upon quick, accurate transfer of information from remote locations to a central control point. With the increasingly high equipment investments in transmitting high voltages, the advantages of the Westinghouse power line carrier become even more important . . . whether the unit is for automatic remote *operation*, *control* or *protection*.

Completely transistorized with printed circuits, the Westinghouse carrier provides a new standard of reliability. In addition to remarkably low maintenance, this unit draws only one-tenth the conventional power, requires but one-twentieth the space. Interchannel interference virtually disappears, allowing more, fully reliable channels in the same band width.

A new concept in distance relaying

The advanced design . . . K-Dar system

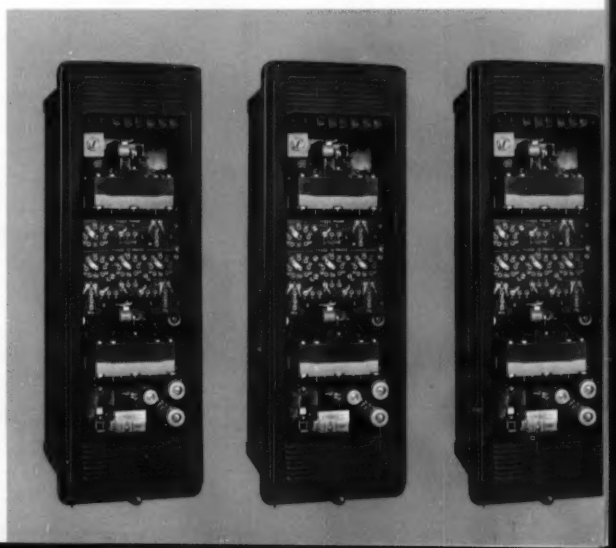
System interruptions on supervoltage transmission lines will be mighty expensive. Damage and outage due to sustained fault current cannot be tolerated . . . nor can the costly repair bill which follows.

The new Westinghouse K-Dar protective relaying system, combined with Westinghouse carrier or micro-wave, provides high-speed simultaneous relay operation at both ends of faulty line sections, permitting maximum service continuity, faster reclosing and improved system stability.

The K-Dar system is the result of wide application and design experience of Westinghouse engineers in Relay, Switchgear, Industry Engineering and associated departments.

The K-Dar distance relay system has a range of 0.75 to 20 ohms and can be set to protect 90 percent of a line section when used as a distance relaying system without carrier transmission. CP-1045

Advanced design, simplified settings, low-burden and high-speed operation add up to reliable protection, ease of application and low maintenance costs.



YOU CAN BE **SURE**... IF IT'S

Westinghouse

Kyova Makes First Conduit Shipment

First shipment of fiber conduit is readied to leave the new plant of Kyova Fiber Pipe Co, Ironton, Ohio. W. D. Kyle, the firm's president, (left, center) hands the shipping papers to Davis E. Geiger, vice president and general manager of the Ben Williamson Co, electrical wholesaler located in Ashland, Ky. Looking on at far left is Jack M. Dollenmaier, vice president of Kyova, and at extreme right is Clarence Maynar of the Williamson organization. Kyova is the producer of bituminized fiber conduit whose output is made exclusively in 10-ft lengths.

S. M. Smith Ships Second Runner to Chief Joseph Dam

The second runner built by S. Morgan Smith Co, York, Pa., for Chief Joseph Dam has been shipped to the dam site near Bridgeport, Wash.

This 100,000 hp, 100-rpm under a 165-ft head, hydraulic turbine will be the 16th installed at the station having ultimately 27 turbines. First of six turbines ordered from this company is in operation.

Insulator with New Ceramic Body Marketed by GE

A switch and bus insulator having high strength and utilizing a new ceramic body is ready for marketing, according to P. R. Hartig, general manager of General Electric Co's Insulator Department at Baltimore, Md.

Known as Locke Cat. 23333, this insulator is said to offer high strength, light weight, small diameter, equal leakage, time proven shell design, and many combination stacking arrangements.

By using the shell arrangement of Cat. 7785—introduced in 1920—identical capacitive characteristics are obtained.

Hartig points out that on horizontally mounted stacks, the 25% weight reduction is equivalent to an additional strength increase. The design and compactness facilitates an interchangeable insulator for high or standard strength use and simplifies inventory problems.

Silicone Aids in Eliminating Seal Replacement Costs

Silicon rubber seals used in high temperature couplings have eliminated cost of seal replacement at

(*Continued on page* 188)

(*Continued from page* 78)

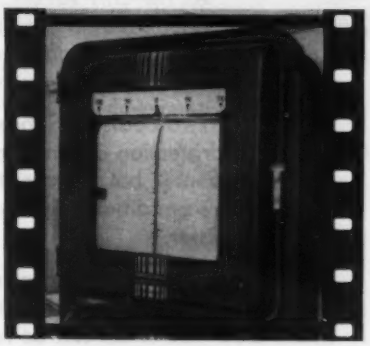
"Something that's never been done..."

the sub-15 cycle preferential rates apply. In such cases, oscillator frequency is 9-15 cycles with performance identical to the 18-30 cycle models.

Reliability

L&N engineers ran two and one-half years of field tests over microwave, power-line carrier and leased communications facilities in order to provide the "peace-of-mind" dependability so characteristic of Leeds & Northrup instruments.

Call us at our nearest District Office, or (in Philadelphia) DAvenport 9-4900, extension 212 — let one of our control specialists give you the full story right now. Or if you prefer, write for more data to 4938 Stenton Avenue, Phila. 44, Pa.



Using new L&N Telemetering System, automatic load controls now start pulsing generators in less than 0.5 second.

SAVE 1 OR 2 COATS OF PAINT ON YOUR NEW PLANT

Start your new plant with Subox protection and save from the very beginning.

As the only American paints made with lead-suboxide, Subox paints provide extraordinary anti-corrosion protection. Lead-suboxide is *chemically active*: Actually works to prevent corrosion.

Two coats of Subox paint generally will give the protection of three coats of standard paint and frequently but one coat is sufficient. Even under severe conditions, Subox paints do not crack, chip or blister.

Eventual repainting costs are minimized because lead-suboxide establishes a dense, metallic lead film which can be recoated without expensive surface preparation.

Available in many attractive modern colors. Write for brochure: *"Plan Painting of New Plants to Reduce Costs"*.

SUBOX PAINTS

Subox Inc
*Trade Mark

Established 1924
3 Fairmount Plant
Hackensack, N. J.

Silicone Aids

(*Continued from page* 187)

the Astoria station of Consolidated Edison Co of New York. The silicone rubber (Silastic) is a product of Dow Corning Corp, and was fabricated by Niagara Rubber Co, Plainfield, N. J., for Victaulic Co, Union, N. J., manufacturer of the couplings.

A total of 234 flexible couplings are installed in the coal-handling lines running from ball mills to boiler fireboxes. They are placed every 10 ft to accommodate the expansion and contraction of the boilers. Temperature of the preheated pulverized coal in these lines is around 150 F, and ambient temperatures, especially near the boilers, range as high as 325 F.

The utility reports that the seals have been in service over a year. They have paid for themselves several times by eliminating labor costs for replacements ranging from $50 to $100 each.

M & M BRIEFS

Brown Co, Bermico Division, has announced a 5% price increase effective on conduit pipe and fittings manufactured at Berlin, N. H., and Corvallis, Ore.

IBM-RCA. International Business Machines Corp and Radio Corporation of America signed recently a non-exclusive agreement exchanging licenses under their respective patents for electronic computers and other processing machines.

DuPont Co has reduced the price of most types of Mylar polyester film by 25 cents per pound. This reduction applies to coated and heat shrinkable types, and to types A and D in all gauges.

Westinghouse Electric Corp, Sunnyvale Division, has designed some very shakey motors for use in Southwestern Engineering Co vibrating screen separators. By use of eccentric weights on both ends of the shaft, these "Rock 'n Roll" motors vibrate the separator screens.

NEW TWO-STATOR NETWORK METER

New economies with Sangamo Type P2S for your fast growing polyphase loads

APPLICABLE TO SMALL LOADS AND LARGE ONES. Range extended in both directions permits meter to start at ¼% of rated load yet operate continuously at 666⅔% of rated load with a maximum temperature rise of 50° C. Gives economies through increased range of application.

APPLICABLE TO SERVICE OF MANY VOLTAGES. Accurate registration without special calibration is provided for circuit variations from 42% to 125% of rated voltage. A single meter, the 240 volt P2, may be used on 120/208, 240/416 and 277/480 network systems, and also on 3 wire 3 phase and 3 wire single-phase circuits. Gives economies through reduced stocks.

TIME SAVED IN ADJUSTMENTS. Only four adjustment points—full load, light load, balance, and power factor—reduce testing and calibration time.

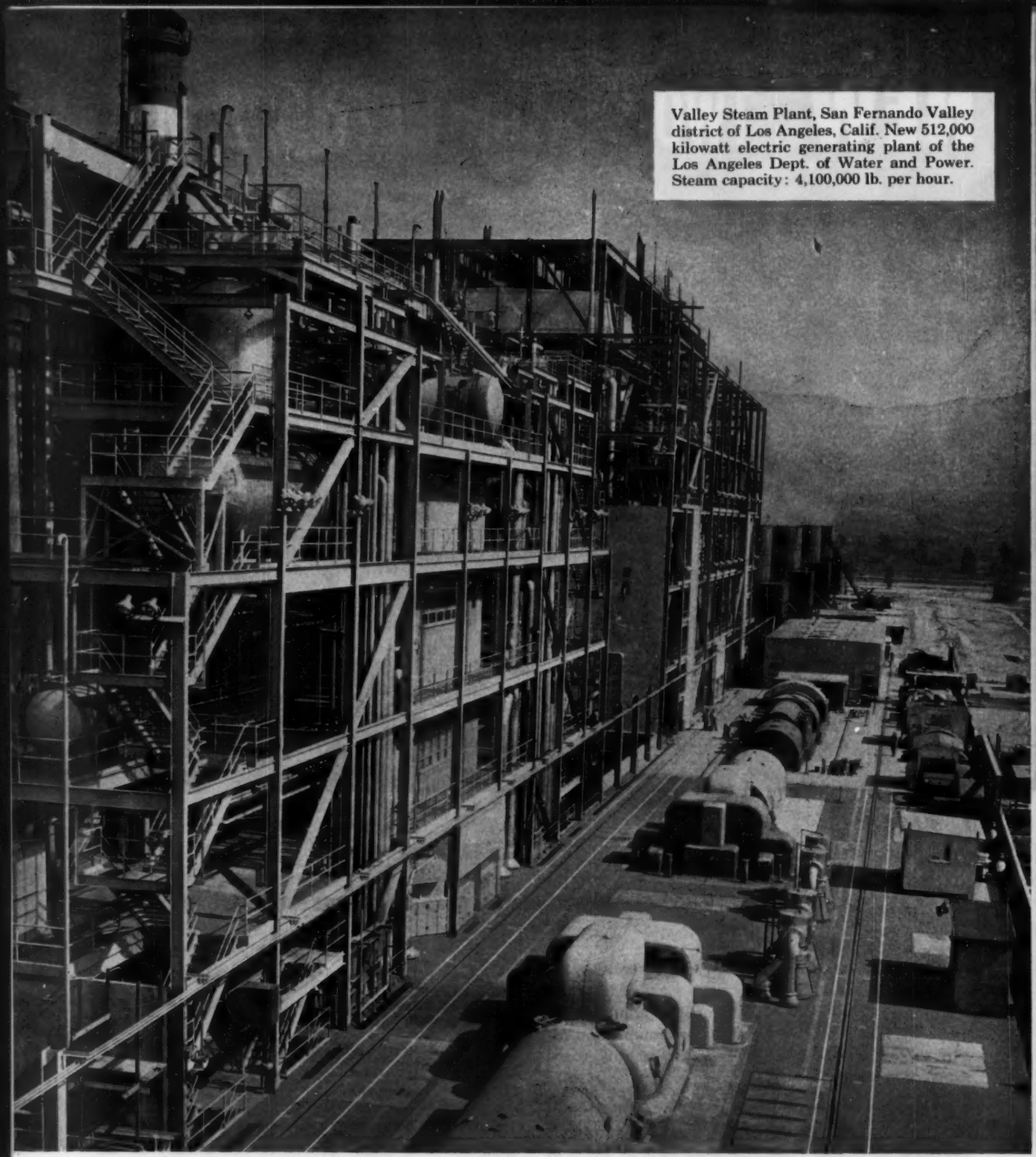
SAVINGS IN HEIGHT AND COVER REPLACEMENT. The Sangamo P2S Meter has been substantially reduced in height. The cover is the same as that used on all singlephase metal base socket meters manufactured since 1936.

PROVEN ECONOMY THROUGH SLOW SPEED. Sangamo *slow speed*—proved so successfully on the singlephase Type J2 Sangamo Meter—gives even greater benefits in two-stator meters. Reduced series damping and fewer revolutions just naturally mean greater accuracy and better performance.

Sangamo Type P Meters will be available for measurement of all types of polyphase service.

SANGAMO *Electric Company*
SPRINGFIELD, ILLINOIS

JMS7-5



Valley Steam Plant, San Fernando Valley district of Los Angeles, Calif. New 512,000 kilowatt electric generating plant of the Los Angeles Dept. of Water and Power. Steam capacity: 4,100,000 lb. per hour.

How big Valley Steam Plant demineralizes

• Valley Steam's feedwater requirements are typical for today's modern, high-capacity stations. Its raw water supply, delivered from the Los Angeles Owens River Aqueduct, contains 132 ppm total solids but is high in dissolved silica (18 ppm). The 1500 psig and 1850 psig boilers require a large amount of high quality feedwater.

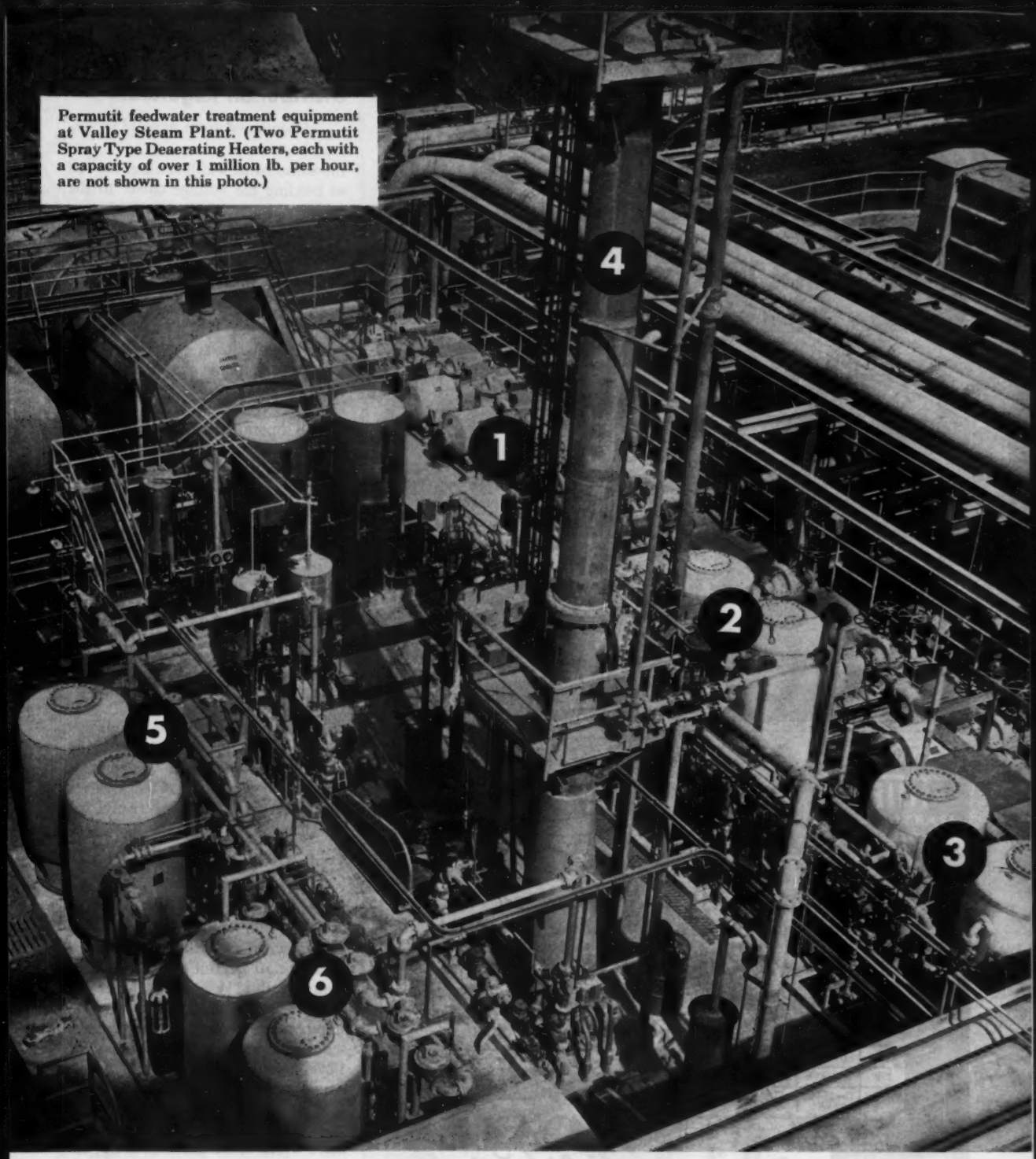
The 4-step PERMUTIT Demineralizer was custom-designed for this problem . . . not only in size, arrangement and number of ion exchange units, but also in the selection of the ion exchange resins.

That's why Permutit's broad experience with many different demineralizing systems and its manufacture of ion exchange resins as well as equipment are of particular value in solving large-plant water problems.

The Permutit Company, Dept. EW-10, 330 West 42nd St., New York 36, N. Y. Permutit Company of Canada, Ltd., 207 Queens Quay, Toronto 1, Ontario.

PERMUTIT EQUIPMENT FOR POWER PLANTS:

Demineralizers • Zeolite and Hot-Process Softeners • Dealkalizers • Deaerating Heaters • Pressure and Gravity Filters • Chemical Feeders • Aerators • Blowoff equipment • CO_2 Indicating Recorders • Zeolites and Resins • Instrument Panels • Control Cubicles



Permutit feedwater treatment equipment at Valley Steam Plant. (Two Permutit Spray Type Deaerating Heaters, each with a capacity of over 1 million lb. per hour, are not shown in this photo.)

its feedwater with PERMUTIT® equipment

1 Diatomite filters (behind column) remove dirt and other suspended matter . . . keep ion-exchanger beds clean for top efficiency.

2 Primary hydrogen cation units contain Permutit Zeo-Karb® . . . remove metallic cations such as calcium, magnesium, sodium.

3 Weakly basic anion units contain Permutit A exchange resin . . . remove chlorides, sulfates, nitrates.

4 Vacuum deaerator removes CO_2 at low cost. Reduces the load on the second stage anion exchangers.

5 Secondary hydrogen cation units (Zeo-Karb) "polish" water by removing "slippage" from first cation units.

6 Strongly basic anion units contain Permutit S-2 resin . . . remove dissolved silica . . . also catch "slippage" from first anion units.

Quality of effluent: Zero free CO_2, under 1 ppm total solids, under 0.2 ppm silica.

For highest efficiency and lowest operating cost, the regeneration of the demineralizing equipment is completely automatic and operated by Permutit instrument panels and control cubicles.

Properly Designed
COOLING RADIATORS

TRANSFORMER TANKS to Specification

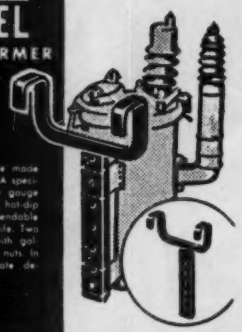
Shaw-Perkins Cooling Radiators are available in a complete range of sizes and models, to give any make and capacity of transformer all the efficiencies of thermosiphon self-cooling. They feature full length oval tubes for optimum heat dissipation, free flow. Flanges, elbows, valves, and other accessories available for any mounting condition.

Transformer tanks, another specialized Shaw-Perkins service to the industry, are engineered and built to customer specification, from pole mounted distribution types to power transformer types up to 3750 KVA.

Write today for full information

SHAW-PERKINS
MANUFACTURING COMPANY
201 East Carson St. • Pittsburgh 19, Pa.

THIEL
TRANSFORMER HANGERS



THIEL Hangers are made according to NEMA specifications — heavy gauge steel construction, hot-dip galvanized for dependable service and long life. Two styles complete with galvanized bolts and nuts. In stock for immediate delivery.

MODEL	1-PHASE	3-PHASE	WEIGHT
T-1	3-15 KVA	9 KVA	16¼ lbs.
T-2	25—37—50 KVA	15-45 KVA	37½ lbs.

C-TYPE HANGERS
Two sizes - for 75-100 KVA 3 phase and 75-112½ KVA 3 phase transformers.

HANGER KICKERS
In sizes to fit T-type Hangers — in four and five mounting positions.

Electrical Fasteners That Hold...
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your future is in your hands
Right now you're holding the one *basic* reference in the electric power industry. Used regularly, it can help you, as it helps more than 26,000 others in all capacities to do a better job, get ahead faster. Get the ELECTRICAL WORLD habit.

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Field Service, INC.
P. O. Box 1581 Okla. City
Thoroughly Specialized
RIGHT-OF-WAY ACQUISITION
From Title Search . . .
. . . To Damage Claims

Distribution Regulators

(*Continued from page 113*)

the same band width setting, as well as holding the voltage closer to the middle of the band width. Again, this is a result of the inverse time characteristic of the voltage relay used with the 16-step regulator. This relay corrects the larger swings in voltage much faster than the integrating type.

During the tests shown in Fig 6 a record was made of the number of operations of each regulator. Theoretically, the 5/8% step regulator should operate twice as frequently as the 1¼% unit. This is literally true for smooth voltage trends upward or downward.

But where the voltage trend changes, the regulator with 1¼% steps operates one extra time. So, by the actual count of all operations during these tests, the regulator with 5/8% steps operated 175 times for each 100 operations of the regulator with 1¼% steps.

The 1¼% step regulator must switch the same current from tap to tap as the 5/8% step unit but at twice the voltage. These regulators are built only through 25 kv, so the voltage per step is low. With 1¼% steps the voltage per step varies from 18 to 108 v, respectively, for 2.5 through 15-kv regulators.

Contact Erosion Important

Extensive laboratory tests show that, for this range in volts per step, doubling the voltage increases the contact erosion at the same current by about 50%. But the 16-step regulator with 1¼% steps operates only 58% as frequently as the 32-step regulator with 5/8% steps. Consequently, the contact material gives 17% greater life in the larger step regulator.

The size of step must, of course, be coordinated with the minimum band width to be used. It is apparent that the band width must be greater than the size of a single step; otherwise, hunting of the regulator results.

A survey has shown that the minimum band width in general use by operators is ±1 v on a 120-v base. The tests previously described show that no improvement in the quality of regulation is obtained by steps smaller than 1¼%.

Tough coverings on Anaconda Heavy Line Wire help solve your primary problem

ANACONDA Heavy Line Wire has been designed to solve your primary distribution problems—with today's higher voltages in mind.

It's made with a tough thermoplastic covering. This covering has high resistance to moisture, weathering and abrasion. It protects conductors from contact with wet and broken limbs—from damage caused by wind, rain, sleet and snow. There's greater freedom from faults, less pruning needed. You save money . . . improve public relations.

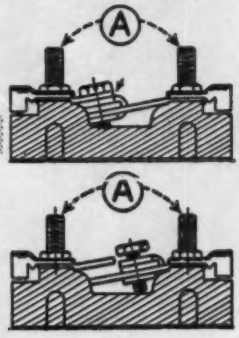
Covering consists either of rugged polyethylene or time-tested Anaconda Densheath* vinyl resin compound. Conductors are being supplied in copper, aluminum, and ACSR.

NEW BULLETIN DM-5705 contains full information, including sizes, diameters, etc., plus special sag and tension charts. See your distributor or the Man from Anaconda for free copy. Or write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y. *Reg. U. S. Pat. Off. 5701

LIVE BETTER ELECTRICALLY

SEE THE MAN FROM **ANACONDA®**
FOR HEAVY LINE WIRE

Here's How
STATES TYPE NT
TERMINAL BLOCKS
Allow Circuit Check Without Disturbing Permanent Wiring



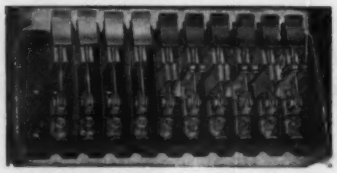
IT'S AS EASY AS A-B-C . . .

A. Just attach instrument to terminal posts.
B. Slide link out of contact—take reading.
C. Slide link back and bolt in position . . . That's all!

States Type NT Terminal Blocks are engineered for quick, safe, economical circuit checking. They're built in any number of pole desired, front or back connected, with or without coding strip, with or without cover.

Make sure your
TEST BLOCKS have
EXCLUSIVE STATES FEATURES

- New Safety Grip Handle assures safer, easier gripping.
- No live parts extend beyond base.
- Maximum pressure at jaw contacts.
- Large selection of pole arrangements.
- Nickel corrosion-resisting finish insures good contact, attractive appearance.
- Angle bent studs permit quick changing of front connection.



"SMK" TEST BLOCKS. Solid base type. Over 2,000 combinations of pole arrangements.

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Address .....
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Thermal Trend . . .

. . . grows in Canada as BC Electric plans a 900-Mw plant in hydro area

Damming of the Columbia River at Mica Creek, considered to be of paramount importance in meeting British Columbia's electrical power needs, has been pushed into the background as result of an announcement by BC Electric Co that it plans to build a 900,000 kw thermal generating plant in the Greater Vancouver area.

Thus, in a province gorged by two of North America's greatest hydro-potential rivers, the Columbia and the Fraser, the electrical power outlook has been revolutionized by BC Electric's disclosure that it has been forced to turn to thermal generation to meet additional demands for power in the next decade.

Construction of the $247-million Mica Creek dam on the Columbia is the focal point of negotiation between Canada and U. S. and long a target of controversy between the British Columbia government and the federal government at Ottawa.

British Columbians had come to accept that construction of Mica Dam would solve the power needs of the province for a long time to come. Now the BCE announcement has changed the entire picture.

In effect, BCE is saying it can no longer wait for a decision to be made on Columbia development, but must go ahead with a generating plant.

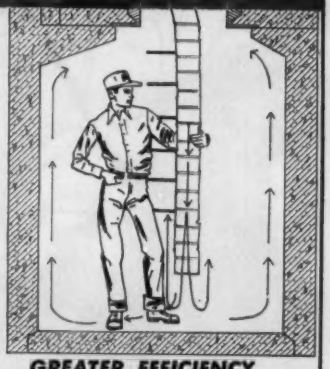
Cost to Pass $100 Million

BCE officials said the plant's minimum cost would exceed $100,000,000. Construction could begin by the end of this year, with a completion date seven years hence.

Three sources of fuel are available—natural gas, oil, and coal from vast deposits of lignite recently discovered in the foothills of the lower Cariboo district.

With the Fraser River cancelled out as a hydro source because of the salmon fishery complication, and with power from the Columbia at least 10 years away, BC Electric says there is no hydro source available to meet the demands of the company after 1960.

Ventilate and Heat Your Manholes with
Mo Pe Co
Ventilating Heaters



GREATER EFFICIENCY
INCREASED SAFETY
BETTER PRODUCTION

300 to 800 CFM fresh air in summer, heated fresh air in winter. 160 watt generator attached provides current for lighting manhole simultaneously.

MODEL PE-G
Portable, PE-G weighs 70 lbs.
Electric models also available.

Write for illustrated brochure on complete line of our products.

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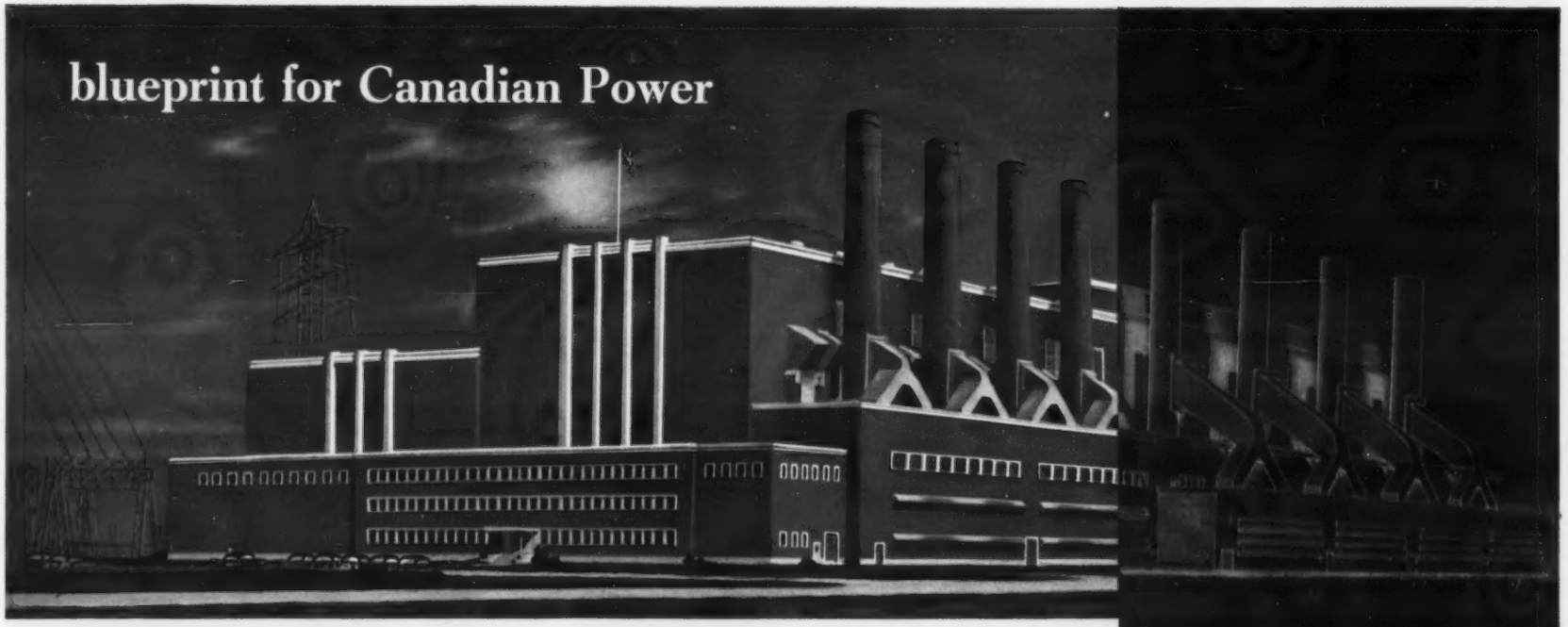

Ontario Hydro's Richard L. Hearn Generating Station in Toronto went on the line in 1951 with 100,000 kilowatts. By 1960 it will be generating 1,200,000 kilowatts . . . an average increase of over 100,000 kilowatts a year! When completed, the Hearn Station will be Canada's largest thermal generating facility.

The Hydro-Electric Power Commission of Ontario awarded the design and construction of the original unit and all subsequent additions to Stone & Webster.

In Canada, in the United States, all over the free world Stone & Webster Engineering Corporation and its affiliates are providing on-the-spot engineering services to many industries. And as a completely integrated organization Stone & Webster can handle a single engineering phase or take full responsibility for the completion of a major project including Design, Construction, Consulting Engineering, Reports, Appraisals and Examinations.

Write or call us for information as to how our experience may be of assistance to you.

1952 – Second 100,000 kw unit went on the line.

1953 – Two additional 100,000 kw units placed in operation.

1960 – Four 200,000 kw units scheduled for completion.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY *of* STONE & WEBSTER, INC.

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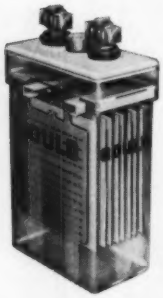
MANAGEMENT NEWSLETTER

For Full Power when it's needed most, specify **gould** batteries...



America's Finest!
GOULD PLANTÉ
The Aristocrat of
Stationary Batteries

Here's why: You know that an overload can cause an unusual drain on your batteries. At such times your batteries must be in "good health" or they may not survive the strain. Keeping batteries in "good health" is not difficult, all it takes are good routine checking procedures which give you a day-by-day record of a battery's condition. By consulting these records frequently you can always be sure of full power when it's needed.

An important part of the Gould service is to help you establish such a sound preventive maintenance program, and teach your battery maintenance personnel the importance of following recommended procedures. This is another reason why it pays you to specify Gould. Want more reasons? Write for booklet "... so you're going to buy an industrial battery." Gould-National Batteries, Inc., Trenton 7, N. J.

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More Power to you from Gould

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ELECTRICAL BUSINESS OUTLOOK

Electrical World
OCTOBER 7, 1956

Most economists are predicting that 1958 will be "a landing on the staircase." Business will level off, but at a much higher level than in '54. What slope there is to the overall business curve will probably be up, but to a nation that remembers the boom of '55 it will be a gradual rise indeed.

Only utilities (and loan companies) are accelerating their expansion programs. Elsewhere in the economy expansion will still go on, but at a slowed pace.

This is true of the electrical manufacturing industry. Electrical machinery manufacturers showed a 50% decline in new appropriations for capital spending during the second quarter, according to the National Industrial Conference Board. During that quarter they cancelled $17 million worth of old appropriations—$1 million more than their cancellations for the entire year 1956, and more than five times as much as during the first quarter of this year.

Next year, economy and inventory reduction will still be the order of the day.

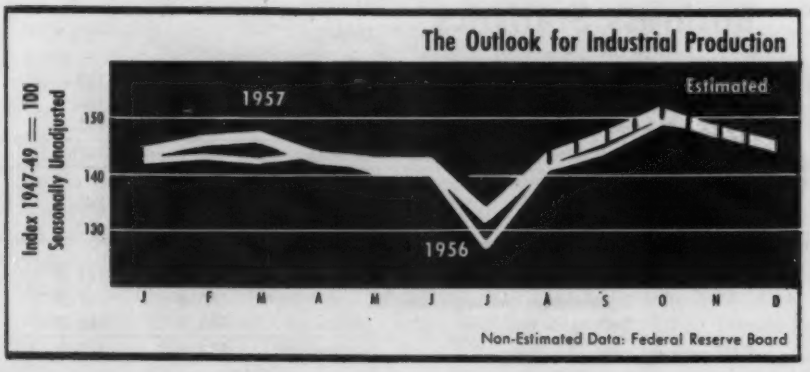
But utilities are sharpening their pencils too. Many of them have been reducing equipment stocks, and ordering closer to the time of need. One of the reasons for carrying large stocks is to assure availability when demand exceeds supply. Another reason is to guard against future price hikes.

Neither of these will influence utilities much in '58. Lower stock levels in the utilities might be expected to build manufacturers' inventories back up again—which would in turn tend to deflate prices.

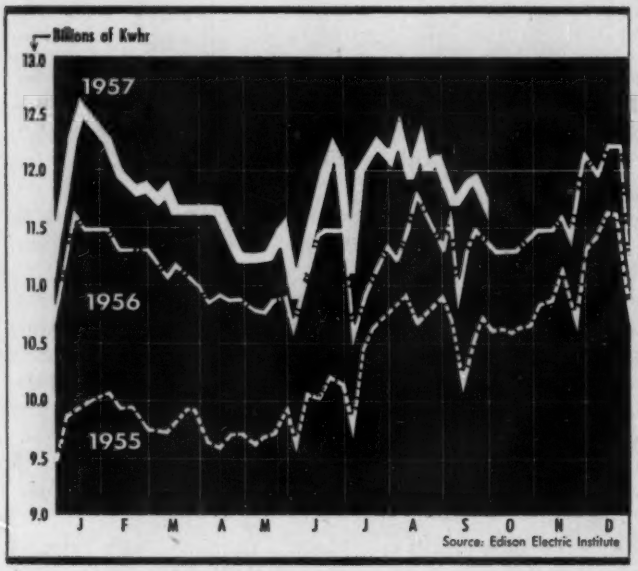
But this deflationary push won't be the whole story. A strict buyers' market implies a high level of supply with lowered demand. Although the supply of electrical equipment will be high next year, demand will be far from low.

Utilities must buy to keep up with their growing load. About $700 million more will go for new plant and equipment next year than this year's budgets called for. While reductions in stock and lead time will defer some expenditures, that still means a healthy number of meters, transformers, and generators will be purchased in '58.

And don't forget next year's guaranteed wage boost in the steel industry. It could not only jack up prices on structural steel—but justify price boosts in many items of electrical equipment.



STATISTICS



OUTPUT

Week ended Sept. 28, 11,697,000,000 Kwhr Up 2.9%

Per Cent Change From Previous Year

	Sept. 14	Sept. 21	Sept. 28
Total U. S.	+5.4	+4.4	+2.9
New Eng.	+6.0	+6.3	+4.1
Mid. Atlan.	+7.1	+7.9	+3.3
Cent. Ind.	+2.1	+2.9	+1.7
West Cent.	+3.0	+2.5	+2.5
Southeast	+7.1	+5.7	+5.0
South Cent.	+6.5	+0.5	−1.2
Rocky Mount.	+3.8	+2.4	+0.9
Pacific			
NW	+8.6	+4.3	+1.6
SW	+8.6	+5.7	+6.7

Seasonally Adjusted Index 224.6
Week Ago 229.8
Year Ago 218.2

Atomic Energy Commission requirements—1,050,000,000 Kwhr (Electrical World estimate). Excluding AEC, output increase was 4.0%.

Power Statistics . . .

		Latest Month	Preceding Month	Year Ago	Annual Change %
Capacity	July	124.99	124.43	117.54	6.3
Peak—Class 1 Systems	million kw—May	97.8	97.7	92.8	5.4
Estimated Dec. '57 Peak	June	113.6	113.6	114.4	−0.7
Production—billion kwhr	July	54.35	52.05	49.45	9.9
Hydro		10.81	11.18	9.91	9.1
Fuel		43.54	40.87	39.54	10.1
Sales—billion kwhr	June	46.99	46.60	44.46	5.7
Residential		11.91	11.86	11.02	8.1
Commercial		7.90	7.38	7.29	8.4
Industrial		24.64	24.89	23.72	3.9
Other		2.54	2.48	2.42	5.0
Fuel Consumption	July				
Coal—million tons		12.72	12.50	12 00	6.0
Oil—million barrels		5.51	6.24	4.32	27 5
Gas—billion cu ft		158.91	125.72	136.97	16.0
Net Income Class A & B Co's $—million	July	100.92	109.69	96.19	4.9
Residential Customers—millions	12 mos	46 26	46.16	44.99	2.8
Revenue per kwhr	ended	2.58¢	2.58¢	2.62¢	−1.5
Avg kwhr per customer	June 30	3,063	3,047	2,879	6.4
Avg annual bill		$79.03	$78.61	$75.43	4.8

Business Statistics . . .

Indexes: 1947–49 = 100					
FRB Industrial Production	Aug.	144	135	142	1.4
ENR Construction Cost	Sept.	154.7	154.8	147.8	4.7
BLS Cost-of-living	Aug.	121.0	120.8	116.8	3.6
New Orders for Machinery (1950 = 100)	Aug.	134	147	142	−5.6
NEMA Sales					
Insulation materials	July	127	140	117	8.5
Electric appliances		101	83	111	−9.0
Wholesale prices	July				
Motors and generators		142.5	141.0	133.1	7.1
Transformers and regulators		150.6	147.8	134.5	12.0
Switchgear and fuses		166.9	166.0	152.6	9.4
GNP—annual rate—$ billion	2nd qtr.	434.4	429.1	410.8	5.7

MANAGEMENT BULLETIN

FINANCE

Weighted overall average cost of money for electric utilities appeared to have increased over 15% in the twelve months ended Aug. 31 (EW, 9/23, p 121).

An aspect which shouldn't be overlooked is the reflection of this increase in money costs in the rate used to capitalize interest during construction. This item customarily represents an estimate of the weighted overall average cost of all types of funds to the electric utility industry.

Those utilities with bonds rated triple "A" would seem justified, under present circumstances, in using a minimum overall rate of 5.5% for interest during construction. Comparable minimum overall rates for companies with bonds rated double "A" and single "A" respectively, would be 5.75% and 6%. Therefore in cases where utilities are presently using rates lower than those mentioned above, an increase to these levels would seem amply justified, although each company's rate should be designed to reflect as nearly as possible its best estimate of overall cost to it of raising funds.

Such increases in the rates used for interest during construction would operate to increase the cost of new facilities and, accordingly, increase the utility's rate base. Also, until the construction projects are completed, net income would be augumented, thus tending to improve market values of the common stock and to reduce the cost of raising common stock equity where this is necessary.

REGULATIONS

"Return Allowed in Public Utility Rate Cases" supplement #1, 1953-56 has just been brought up to date by Arthur Andersen & Co. The staff of this company has summarized 1,032 public utility rate cases decided during the period 1915-1956. Here's what the study shows:

With respect to rate base, these commissions have adopted original cost: Alabama, Arkansas, California, Colorado, Connecticut, District of Columbia, Florida, Idaho, Louisiana, Massachusetts, Missouri, New Hampshire, New York, Oklahoma, Oregon, South Dakota, Utah, Vermont, Virginia, Washington, Wisconsin, Wyoming, and Federal Power Commission.

Fair value rate base is required by statute in these states, but commissions have modified the traditional concept by giving sole or predominant weight to original cost evidence: Georgia, Kansas, Kentucky, Minnesota, New Jersey, Rhode Island, and West Virginia.

Fair value is still the test of a lawful rate base in these states, although for various reasons original cost of investment has been adopted in a number of decisions: Delaware, Illinois, Indiana, Maine, Maryland, Michigan, Montana, New Mexico, North Carolina, North Dakota, Ohio, and Pennsylvania.

With respect to rate of return, these commissions have given substantial weight to cost-of-capital evidence, with particular emphasis on historical cost of debt and preferred stock and current common stock earnings-price and dividend-price ratios: California, Connecticut, Georgia, Idaho, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Pennsylvania, South Dakota, Wyoming and Federal Power Commission.

These commissions have considered, as primary evidence, current earnings requirements based on contractual interest and preferred stock dividend costs and established common stock dividends together with a reasonable increment to surplus: Alabama, Arizona, Arkansas, California, Colorado, Delaware, District of Columbia, Florida, Hawaii, Idaho, Illinois, Indiana, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Montana, Nebraska, New Hampshire, New York, Ohio, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Washington, West Virginia, and Wisconsin.

These commissions have recognized attrition of earnings because of high cost of plant replacements and increasing operating expenses, and have adjusted return allowance through rate base or rate of return: Alabama, Arkansas, California, Colorado, Florida, Georgia, Idaho, Missouri, New Hampshire, South Carolina, South Dakota, and Utah.

These commissions have considered risk differentials of type of utility service, geographical location and markets, and size and economic stability of the industry: Alabama, Arkansas, California, Connecticut, District of Columbia, Florida, Kentucky, Michigan, New Hampshire, New Jersey, Utah, Vermont, Virginia, Wyoming, and Federal Power Commission.

These commissions have given substantial weight to evidence of current earnings opportunities in other industries: California, Connecticut, District of Columbia, Florida, Illinois, Maine, New Mexico, Oregon, Pennsylvania, South Dakota, and Vermont.

If you are interested in receiving a copy of this study, you can write Arthur Andersen & Co, 67 Broad St, New York 4, N. Y.

RATES

A $4,725,000 refund to customers of Florida Power & Light Co was ruled out by the Florida Railroad & Public Utilities Commission because it had no authority to order the money given back. PUC earlier had ordered FP&L to reduce its rates on grounds the company's earnings were excessive.

A petition filed by Troy Haigler, Miami tax consultant, asking the PUC to order FP&L to refund the money to the customers, was denied by the commission. The PUC said the rate on which the company collected the excess revenues was legal and it had no power to order a refund. It also said that Haigler had made no showing in his petition that he was a customer or that he represented any customers of the utility.

FP&L had voluntarily reduced its rates on order of the PUC rather than risk the effect of a rate fight on its program for financing a large expansion program in the next few years.

ACQUISITIONS

Texas Power & Light Co buys Terrell municipal plant. Citizens of Terrell voted 853 to 685 to sell it for $1.4 million. Elections was hotly contested, with three city commissioners in favor of calling the election and two against it. An election on the same issues was held in Terrell 27 years ago, at which time the TP&L proposal to purchase the plant was defeated.

PUBLIC RELATIONS

"The Atom Comes to Town", a 16mm sound color film running 29 minutes is now available. It was prepared under auspices of the U. S. Chamber of Commerce. It is designed to help increase understanding of the peacetime atom. For further info, write Edwin Vennard, managing director, Edison Electric Institute, 420 Lexington Ave, New York 36.

"Finer Farms" contest of Carolina Power & Light Co gets underway this month. Cash prizes will total $2,800. A total of 51 counties in North Carolina and 12 in South Carolina in which CP&L serves are eligible to compete. If you are interested in running such a contest, you can contact Ned Champion, contest director, CP&L, Raleigh, North Carolina.

Are you interested in facts about the city of Atlanta, Ga.? If so, the industrial bureau of the Atlanta Chamber of Commerce has just gotten out a 42-p booklet entitled "Facts in Figures about Atlanta. Copy can be secured by writing Paul W. Miller, CofC, Atlanta, Ga.

CHANCE Hot Line Tools ARE *Aluminum Fitted* FOR LIGHTER WEIGHT

WIRE TONG

Easier to handle... Cause less fatigue

Chance Hot Line Tools are lighter in weight at the end of the pole—*where weight is important.* The end castings are made of heat-treated aluminum alloy . . . stronger fittings with less weight . . . tools with better balance to cut down fatigue, relieve strain on the lineman.

Chance Hot Line Tools help your crews do easier, safer, more efficient hot stick work. There are Chance tools to work all voltages from 6900 to 345,000 volts.

YOUR HOT LINE CREWS NEED THIS MANUAL

"Hot Sticks" is the most complete live line maintenance manual ever published. It has been used by supervisors and safety men all over the country to train hot stick crews in the safe way to do high voltage line maintenance. It talks the linemen's language—shows hundreds of detailed how-to-do-it drawings and diagrams for every operation. Every live line crew member should have a copy. Use the coupon to place your order.

O. G. "Andy" Anderson, America's best-known hot stick man, has tested and approved the design of all Chance Tools. That's why he says:

"GIVE THE MAN ON THE POLE A CHANCE FOR SAFETY"

Serving the Utility Industries since 1907

50TH ANNIVERSARY
H. B. CHANCE COMPANY

CHANCE
Hot Line Tools
ARE *Aluminum Fitted*
FOR LIGHTER WEIGHT

WIRE TONG

Easier to handle... Cause less fatigue

Chance Hot Line Tools are lighter in weight at the end of the pole—*where weight is important.* The end castings are made of heat-treated aluminum alloy . . . stronger fittings with less weight . . . tools with better balance to cut down fatigue, relieve strain on the lineman.

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CHAN
Hot L
Too
ARE *Plastic A*
FOR GREATER SAFETY...

AND

The poles used on all Chance
pletely sealed and protected w
super-tough plastic finish that
moisture absorption, is not affect
or salt water. "Maplac" provi
against finish damage but can be
sary. Its transparency permits visu

WIRE TONG SADDLE

EASY TO

Chance Hot Line T
on power poles with a
lever-action chain tigh
safety latch automatica
support in place . . . a
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seconds. The tightene
leased accidentally — t
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powerful grip.

ANCE
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ID DURABILITY

hance Hot Line Tools are com-
ed with Chance "Maplac," a
that resists abrasion, retards
affected by oil, grease, gasoline
provides maximum protection
an be readily repaired if neces-
ts visual inspection of the wood.

O ATTACH

ine Tools are mounted
vith an easy-to-operate
n tightener. A special
natically locks the tool
. . . a half link adjust-
ht fit on any pole in
htener cannot be re-
ly — two simultaneous
ecessary to release its

LP (LINEMEN'S PREFERENCE) Tools

Here's the new, easier way to select hot sticks for your maintenance crews. LP means Linemen's Preference—a term we've applied to the hot line tools used most and *preferred* by most linemen who *know* hot stick work. LP is like a seal of approval for hot line tools that have earned this rating. The list was developed by combining linemen's selections, determined by a nationwide field survey, with the preferred tools of our own demonstrators who do all kinds of hot stick jobs.

The list includes straight line tools, dead end tools, platforms, ladders, hand tools—everything required for hot stick work.

The LP list is valuable to you because it helps you select tools that your line crews will really like and use. We've printed a complete listing of these tools, punched to fit your CHANCE CATALOG. Use the coupon below for your copy.

A. B. CHANCE COMPANY
CENTRALIA, MISSOURI

Please send me the following items by return mail:

☐ Quantity — **New free handy list of "Linemen's Preference" Tools.**

☐ Quantity — **Copies of "Hot Sticks" @ $2.50 a copy. Bill us. ___**
Our check is enclosed. ___

NAME & TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

CT57-6

NEW

CHANCE LIGHTWEIGHT ALUMINUM GROUNDING EQUIPMENT

Easier to handle . . . takes No. 4 to 4/0 Cable

The safety and efficiency of linemen using temporary grounds for line repairs depends, in part, on the weight of the tools they use.

These new grounding clamps and "cluster bar"—typical of the complete new line of Chance temporary grounding equipment — are made with aluminum alloy to lighten the load on the end of the insulated poles.

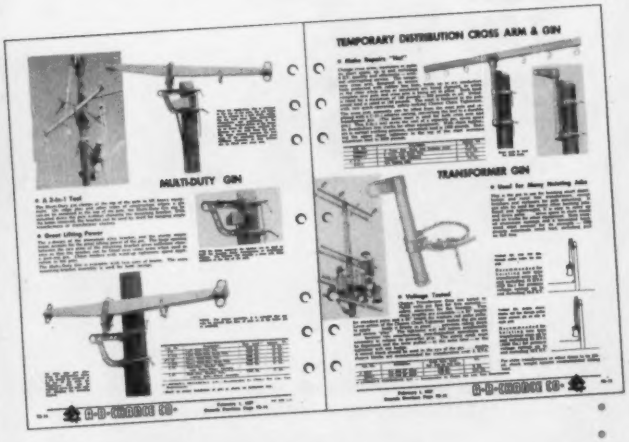
Another feature of importance to the user of Chance grounding clamps is the increased range in the jumper terminal size. Two sizes are available to accommodate cable from No. 4 minimum to 2/0 maximum or from No. 4 minimum to 4/0 maximum.

Chance grounding clamps are designed with "duck bills" that are easy to hook over the conductor and have fast action threads that screw up tight in a hurry.

Chance grounding clamps are available unmounted for handling with a clamp stick or mounted on laminated plastic-coated poles—the same as used on Chance hot line tools. The "Maplac" plastic coating is crystal clear, making it possible to visually inspect the wood. All poles are tested to withstand 75,000 volts per foot for five minutes.

The new clamps must pass constant current-carrying capacity tests and short circuit tests that guarantee their performance.

CHANCE Lifting Gins can be used many ways



The Chance Multi-Duty Gin is a 3-in-1 tool with great lifting power. It can be used on top the pole, down the pole, or without the beam as a transformer gin. The Temporary Distribution Cross Arm and Gin is a two-way tool that can be used as a temporary arm to support conductors for pole, arm, or insulator changes, or can be quickly converted to a transformer gin. The small Chance Transformer Gin is a lightweight, quickly applied tool for many lifting jobs. See your Chance Catalog Sheets 7B-13 and 14 for information.

Protect your tools with the CHANCE trailer

Tools are protected from the weather, from scuffs and other physical damage when you use the Chance Hot Line Tool Trailer. They arrive on the job dry, safe, ready and handy for use. Chance Trailers are especially designed to carry hot line tools, and to make them easily accessible to your crews. Two types of trailers are available, the Heavy-Duty Trailers, shown above, and a sturdy Light-Weight Trailer that is easily transported by small pick-up trucks. Ask your Chance Representative, or write for full information and prices.

A·B·CHANCE CO·

ABC INDUSTRIES

MEETINGS CALENDAR

OCTOBER

Edison Electric Institute—LBE Press Conference, New York City, Oct. 7; Mid-Atlantic Home Service Workshop, Philadelphia, Pa., Oct. 7-8; Prime Movers Committee, Hotel New Yorker, New York City, Oct. 7-9; Home Service Committee, Philadelphia, Pa., Oct. 9; Commercial Division Executive Committee, New York, N. Y., Oct. 9-10; Area Development Workshop, Phoenix Hotel, Lexington, Ky., Oct. 9-11; Transmission & Distribution Committee, Statler Hotel, Boston, Mass., Oct. 17-18; Insurance Committee, Dearborn Inn, Dearborn, Mich., Oct. 17-18; Accounting Division Taxation Accounting Committee, held jointly with AGA, Williamsburg, Virginia, Oct. 23-25.

Iowa Utilities Association—Management Conference, Hotel Fort Des Moines, Des Moines, Iowa, Oct. 7-8.

Pennsylvania Electric Association—Communications Committees, Abraham Lincoln Hotel, Reading, Pa., Oct. 7-8; Meter Committee, Shenango Inn, Sharon, Pa., Oct. 10-11; Relay Committee, Abraham Lincoln Hotel, Reading, Pa., Oct. 17-18; Systems Operations Committee, Bedford Springs Hotel, Bedford, Pa., Oct. 24-25; Transmission & Distribution Committees, Lord Baltimore Hotel, Baltimore, Maryland, October 31-November 1.

American Society of Mechanical Engineers—Lubrication Conference, sponsored jointly with American Society of Lubrication Engineers, Royal York Hotel, Toronto, Canada, Oct. 7-9; Power Conference, American Hotel, Allentown, Pennsylvania, Oct. 21-23.

National Electronics Conference, Inc—13th Annual Meeting, Hotel Sherman, Chicago, Ill., Oct. 7-9.

American Institute of Electrical Engineers—Fall General Meeting, Morrison Hotel, Chicago, Ill., Oct. 7-11; Computers in Control Symposium, Hotel Claridge, Atlantic City, N. J., Oct. 16-18; 3rd Annual Farm Electrification Conference, Hotel Nicollet, Minneapolis, Minn., Oct. 29-31.

Electrical Association of Philadelphia—15th Electrical Progress Show, Convention Hall, Philadelphia, Pa., Oct. 8-10.

Canadian Electrical Manufacturers Association—13th Annual Meeting, Sheraton-Brock Hotel, Niagara Falls, Ontario, Canada, Oct. 9-11.

Southeastern Electric Exchange—Accounting Section, Fort Sumter Hotel, Charleston, S. C., Oct. 10-11; Sales Section, Dinkler-Tutwiler Hotel, Birmingham, Ala., Oct. 16-18.

Rocky Mountain Electric League—54th Annual Convention, Broadmoor Hotel, Colorado Springs, Colo., Oct. 13-17.

Interstate Power Club—Hotel Martinique, New York City, Oct. 14.

Pennsylvania State University—Electric Utility Company Managers Seminar, State College, Pa., Oct. 14-16.

American Society of Civil Engineers—Annual Meeting, Hotel Statler, New York City, Oct. 14-18.

Wisconsin Utilities Association—Electric & Gas Sales and Operating Sections Convention, Schroeder Hotel, Milwaukee, Wis., Oct. 16-18.

National Society of Professional Engineers—Fall Meeting, Grand Pacific Hotel, Bismarck, North Dakota, Oct. 17-19.

National Safety Congress—Conrad Hilton Hotel, Chicago, Ill., Oct. 21-25.

Engineers Council for Professional Development and Engineers Joint Council—General Assembly, Statler Hotel, New York City, Oct. 24-25.

Oklahoma Utilities Association—Electric Light and Power Division, Woodward, Okla., Oct. 25; Eastern District, Bartlesville, Okla., Oct. 25.

American Power Dispatchers Association, Inc—Fall National Meeting, Fresno, Calif., Oct. 25-26.

• **National Management Association**—34th National Conference, Penn-Sheraton Hotel, Pittsburgh, Pa., Oct. 25-26.

Atomic Industrial Forum—Annual Conference, New York City, Oct. 28-30.

American Nuclear Society—Winter Meeting, New York City, Oct. 28-30.

The University of Texas—10th Annual Power Distribution Conference, Austin, Texas, Oct. 28-30.

National Association of Railroad Utilities Commissioners—Annual Conference, Peabody Hotel, Memphis, Tenn., Oct. 28-31.

Industrial Management Society—21st Anniversary Industrial and Management Clinic, Hotel Sherman, Chicago, Ill., Oct. 30-Nov. 1.

Institute of Radio Engineers—3rd Annual Technical Conference of the Professional Group on Electron Devices, Shoreham Hotel, Washington, D. C., Oct. 31-Nov. 1.

NOVEMBER

American Institute of Mining, Metallurgical, and Petroleum Engineers—Metals Division Fall Meeting, Morrison Hotel, Chicago, Nov. 3-7.

American Institute of Electrical Engineers—Ninth Annual Machine Tool Conference, Hotel Schroeder, Milwaukee, Wis., Nov. 4-6; Conference on Magnetism & Magnetic Materials, Sheraton Park Hotel, Washington, D. C., Nov. 18-21.

Edison Electric Institute—Accident Prevention Committee, Penn-Sheraton Hotel, Pittsburgh, Pa., Nov. 6-8; Southern Region Home Service Workshop, Atlanta, Ga., Nov. 12-13; Accounting Division Advisory and Executive Committees, The Cloisters, Sea Island, Ga., Nov. 14-15; Street Lighting Committee, Dayton, Ohio, Nov. 21-22.

Pacific Coast Electrical Association—Hawaiian Conference, Reef Hotel, Honolulu, Hawaii, Nov. 7-8.

Pennsylvania Electric Association—Prime Movers Committee, Bedford Springs Hotel, Bedford, Pa., Nov. 7-8; System Planning Committee, Van Curler Hotel, Schenectady, N. Y., Nov. 7-8; Electrical Equipment Committee, Ben Franklin Hotel, Philadelphia, Pa., Nov. 14-15.

Institute of Radio Engineers—Third Annual Instrumentation Conference, Atlanta Biltmore Hotel, Atlanta, Ga., Nov. 11-13.

National Electrical Manufacturers Association—Traymore Hotel, Atlantic City, N. J., Nov. 11-15.

• **American Standards Association**—Eighth National Conference, St. Francis Hotel, San Francisco, Calif., Nov. 13-15.

• **Southeastern Electric Exchange**—Accident Prevention Committee, Dinkler-Tutwiler Hotel, Birmingham, Ala., Nov. 14-15.

• **American Society of Refrigerating Engineers**—44th Semi-annual Meeting, Shoreland Hotel, Chicago, Ill., Nov. 14-16.

Electric Companies Public Information Program—Inter-Regional Committee, Mayflower Hotel, Washington, D. C., Nov. 19.

• Additions this week.

How Bailey stretches

You can wring more energy out of a dollar's worth of fuel when you are getting optimum performance from your steam plant equipment. You get peak performance when Bailey Meters and Controls are on the job. They increase your plant efficiency.

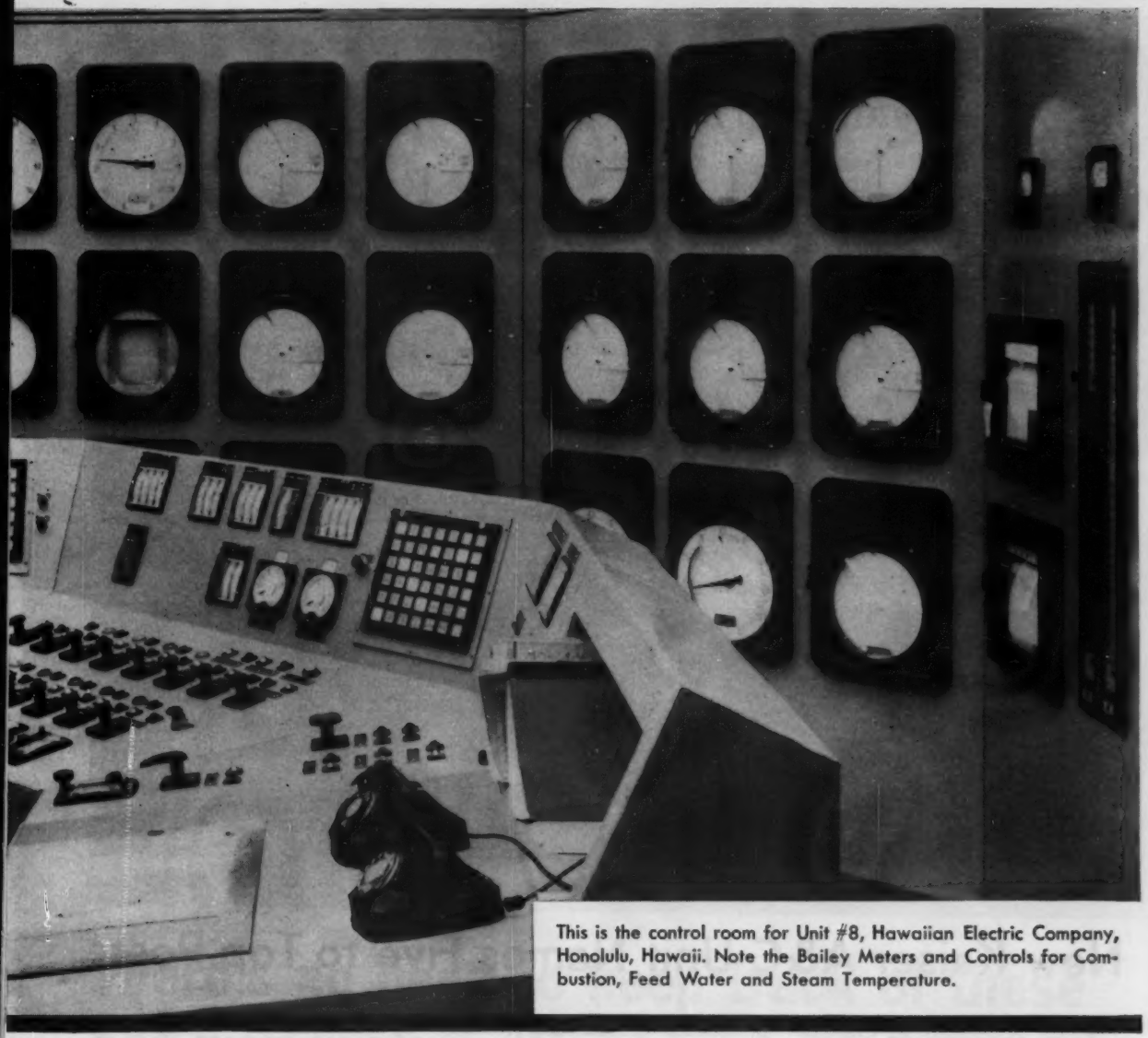
Bailey is the choice of virtually all the most efficient plants on the Federal Power Commission's heat rate report. Here's why:

1. A Complete Line of Equipment

You can be sure a Bailey Engineer will offer the right combination of equipment to fit your needs. Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems in measurement, combustion, and automatic control are your assurance of the best possible system.

2. Experience

Bailey Engineers have been making steam plants work more efficiently for more than forty years. Veteran engineer and young engineer alike, the men



This is the control room for Unit #8, Hawaiian Electric Company, Honolulu, Hawaii. Note the Bailey Meters and Controls for Combustion, Feed Water and Steam Temperature.

your fuel dollar

who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.

A132-2

BAILEY METERS

Instruments and controls for power and process

BAILEY METER COMPANY

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In Canada—Bailey Meter Company Limited, Montreal

PRDC Advances Hartwell

The appointment of Robert W. Hartwell as general manager of Power Reactor Development Co has been announced by Walker Cisler, president.

Since last year Hartwell has served as assistant general manager of PRDC, which is constructing the Enrico Fermi nuclear power plant near Monroe, Mich.

Hartwell, who has been associated with Detroit Edison Co since 1940, first entered the industrial atomic energy development field as assistant director of Detroit Ed's nuclear power development department in 1954. He had previous experience with the naval reactors branch of the Atomic Energy Commission, where he worked on reactor projects, including the unit installed in the atomic submarine Nautilus. A graduate of the University of Michigan Engineering College, Hartwell also holds an advanced degree in business administration.

ROBERT W. HARTWELL

J. T. DUGALL | C. W. HIGBEE | G. N. HOUCK | F. S. BARTLETT | J. S. URBANIK

New Kaiser A&C Unit Names Five to Top Posts

Kaiser Aluminum & Chemical Corp has named J. T. Dugall as general manager of its newly established Electrical Conductor Division.

The new division will have Clarence W. Higbee as assistant general manager and Gillette N. Houck as sales manager. F. S. Bartlett continues as works manager of the insulated products mill at Bristol, R. I., and J. S. Urbanik continues as works manager at the Newark, Ohio, wire-cable plant.

The Electrical Conductor Division is one of five major divisions formed recently to enable the company to place greater emphasis on the production and sale of individual products. Dugall, as its general manager, will assume full responsibility for the expanded range of electrical wire and cable products.

Dugall was named manager of the company's Newark plant in 1949, after many years of technical and production experience in the wire and cable industry. Recently he has served as operations manager for the firm's plants at Newark, Bristol, Halethorpe, Md.; Erie, Pa; and Dolton, Ill.

Higbee is a veteran of nearly 40 years in the electrical conductor industry. He joined Kaiser earlier this year when it purchased the wire and cable business of United States Rubber Co. He had been with the latter firm since the end of World War I in a variety of production and sales capacities including manager of the wire and cable department, his most recent position.

Houck, in his new capacity, will be in charge of the nationwide sales program for electrical conductor products, serving electric utilities, industrial accounts, electrical wholesalers, and original equipment manufacturers. A ten-year Kaiser veteran, he has held a variety of sales and executive sales positions in Kansas City, Newark, and Chicago. He most recently was product manager of electrical conductor products.

Bartlett joined Kaiser as Bristol works manager early in 1957, when the company purchased the plant. He had been with U. S. Rubber at Bristol since 1926 in a number of technical and management positions.

Urbanik, works manager at Newark since 1954, has been with the firm eight years. He previously served as plant superintendent and general superintendent.

ALL HE'S CHECKING IS WHAT'S ON THE REELS —NOT THE REELS THEMSELVES. These convenient one-way reels are now available with Rome's building wire, Triplex SD, and line wire.

There's no need to keep track of these one-way reels . . . they're non-returnable

Now available in all bldg. wire through 500MCM, Triplex SD, and line wire

The non-returnable reel—first adopted as a standard by Rome Cable—gets rid of many of your recording, reshipping, and inventory headaches. Here are some of the ways it benefits you:

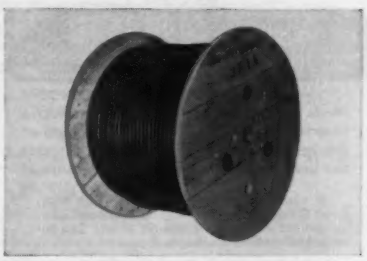
Eliminates bookkeeping costs. You avoid the extra paper work brought on by billing, crediting, and storing of returnable reels.

Saves storage space. When the wire or cable is used up, you simply destroy the reel or throw it away.

Handles easier. Rome's non-returnable reel is lighter to handle than an ordinary reel—yet sturdy and quite adequate for normal service.

All these benefits are now available to you with all Rome's building wire through 500MCM, Triplex service drop cable, and line wire.

Be sure to consider the advantages of Rome's standard non-returnable reel package when you place your next wire or cable order. Contact your nearest Rome Cable representative for more information—or write to Dept. 139, Rome Cable Corporation, Rome, N. Y.



ROME CABLE

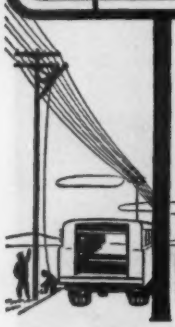
CORPORATION

INDIANA STEEL & WIRE CO. Crapo Galvanizing MUNCIE, IND.

Signs along the lines of *Crapo* GALVANIZED STEEL STRAND PERFORMANCE

For dependable performance . . . insist upon *Crapo* Galvanized Steel Strand. Superior tensile strength, combined with long-life, ruggedness and workability, makes *Crapo* Steel Strand first choice for guys, messenger and overhead ground wire.

The famous *Crapo* galvanizing process provides dependable protection for the steel, prolongs the expectant life of the strand.



- Low maintenance cost
- Laboratory tested and controlled quality
- Meets highest quality standards
- A size and grade for all practical needs
- Contact your *Crapo* Jobber Today!

INDIANA
STEEL & WIRE CO., INC.
Muncie, Indiana

Two New Minerallac Quality Products Designed for Jobs Too Heavy for Standard Jiffy Clips

MINERALLAC
Heavy Duty AND Medium
JIFFY CLIPS

Also available without mounting hole for use with gun.

patent pending

Made of heavier materials! Has exclusive inverted rib, that provides more strength at the bend of clip . . . and, of course, adds the benefits of famous "Snap On" feature!

In stock in Zinc-Plated Steel for Thin Wall or Rigid Conduit up to 6". (Hot Dipped Galvanized may be obtained on order) Can be substituted for malleable clips.

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MINERALLAC

Corette is U. S. Delegate To UN Electric Power Meet

J. E. Corette, president and general manager of Montana Power Co, has been chosen by the State Department as U. S. delegate to the 15th annual session of the United Nations' committee on electric power.

The conference, which meets this week in Geneva, Switzerland, will study various problems of electric transmission across frontiers and rural electric problems. The committee is a subsidiary body of the U. N. Economic Commission for Europe.

PERSONAL BRIEFS

Dean Smith has advanced to assistant purchasing agent of Interstate Power Co. . . . Kansas Power & Light Co has named **Bryce Kresie** to the new post of director of employee relations.

Iowa-Illinois Gas & Electric Co has named **James Berry** superintendent of the Moline generating station . . . At Ohio Power Co, **S. A. Harpar** was promoted to operation supervisor and **Robert W. Jurgensen** to maintenance supervisor of the new Kammer plant.

Detroit Edison has made the following appointments: **A. J. Gebauer,** to director of electronic programming; **G. E. Greenwood** to electrical apparatus engineer, electrical system; **A. J. Provencher** to staff assistant to

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5752 Highland Ave., Niagara Falls, N. Y.

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Type "R" Pull-A-Ways

WEIGH LESS THAN 9 POUNDS

Write for Bulletin 163-B

5-foot double strand, 3000-lb. pull

14-foot single strand 1500-lb. pull

Sturdy • Light • Safe • Economical

Here are some of the fine features of WRIGHT Type "R" Pull-A-Ways:

Drop forged ductile aluminum alloy frame • Wire hoist cable of maximum strength and flexibility • 8' minimum handle movement—for close hook-ups • 2" drum hub for cable • No oiling needed • Drop forged steel hooks • Removable, reversible "Safety Handle" that bends before any part of hoist is overloaded • Automatic load lowering, with positive control for safety. ACCO

Write our York, Pa., Office for Bulletin DH-163B for full story

Wright Hoist Division
AMERICAN CHAIN & CABLE
Bridgeport, Conn. • York, Pa.

the general accountant; **W. M. Remington** to director of the mechanical data processing department; and **Norman Sache** to concrete division engineer, design engineering department.

Northern States Power Co has appointed **L. D. Kneen** as merchandise manager, general office to succeed **Harold G. Huey** who has retired.

Ambrose J. Gegan, Jr, is new design and construction engineer in the production department of Jersey Central Power & Light Co and New Jersey Power & Light Co.

Ewell M. Alexander has been made real estate and claims supervisor and **Y. Allen Beall** director of personnel and safety at Savannah Electric & Power Co.

New chairman of the National Wiring Bureau is **Lester E. Barrett,** president of Barrett Electrical Supply Co . . . **Ralph M. Besse,** executive vice president of Cleveland Electric Illuminating Co, has been elected to a three-year term as director of American Management Assn.

American & Foreign Power Co's **Jackson Hoagland** has been appointed assistant vice president of Cia Chilena de Electricidad in Santiago, Chile.

W. Warren Woodruff has retired as director of TVA's Division of Power Engineering and Construction.

OBITUARY

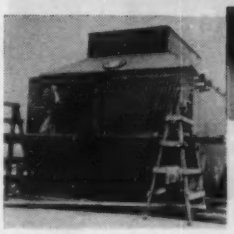
Robert B. Donworth, 60, vice president of the Engineering and Construction Division of Duquesne Light Co, died while undergoing an operation at West Penn Hospital, Pittsburgh, Pa. He previously served as manager of the utility's atomic power development department.

G. O. House, 87, retired manager of Northern States Power Co's St. Paul Division from 1918 to 1945, died at his St. Paul home recently.

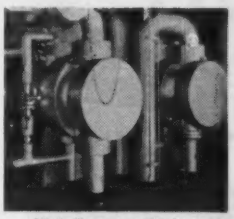
Ohmer E. Howland, 71, retired vice president and treasurer of Dayton Power & Light Co, died recently.

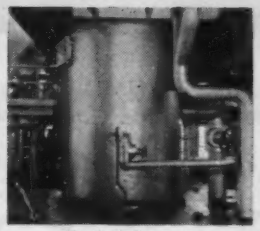
CONSECO

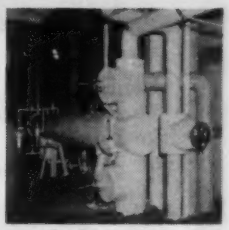
A THIRD OF A CENTURY OF ENGINEERING EXPERIENCE

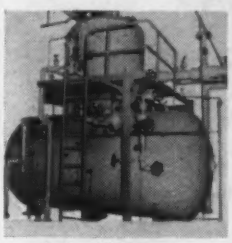

45,000 Sq. Ft. Condenser

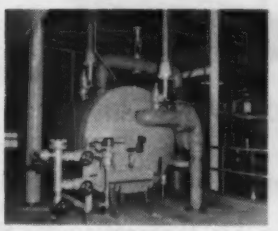
Condensate Cooler

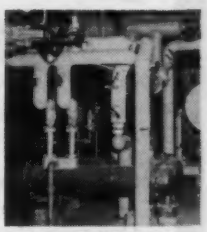

High Pressure Heaters

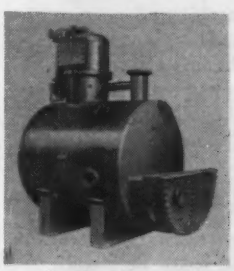

Vertical Deaerator


Feedwater Heater


Horizontal Deaerator


Evaporator


Steam Jet Air Ejector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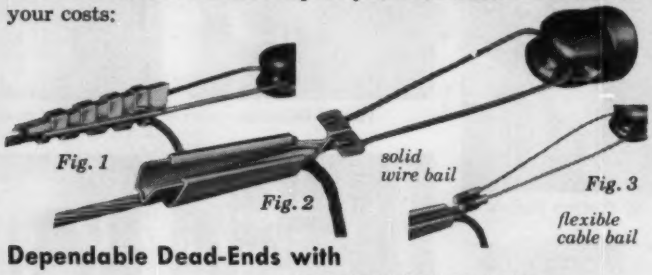
Save on Installation and Maintenance Costs

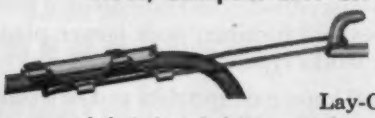
Here are just a few of the KEARNEY tested and field-proved Pole Line Accessories which speed your construction . . . reduce your costs:



Dependable Dead-Ends with WEDGE-TITE CLAMPS

Simple, economical . . . for bare neutral self-supporting service cable. Develop high holding strength to safely support span. One-piece clamps (Fig. 1) are constructed so parts can't become separated during installation. Time-saving two-piece clamps (Fig. 2 and 3) do not require neutral to be threaded through clamp.

Neat, Compact LAY-CIT CABLE GRIPS



For aerial and service cable. Double-gripping action of aluminum Lay-Cit plates and extra holding power of their knurled inner surfaces make this clamp particularly efficient on modern synthetic-jacketed cables.

Simple, Inexpensive SPAN CLAMPS

Dead-end service wire to bare neutral of secondary in mid-span. To install, slip clamp on secondary neutral, tighten single bolt.

Easily Installed SERVICE CABLE TIES

Secure insulated wires to bare neutral, preventing separation of conductors. Soft aluminum; install with fingers.

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JAMES B. KEARNEY CORPORATION, *General Offices:* **4224-42 Clayton Ave., St. Louis 10, Mo.**

for BETTER CONSTRUCTION SAFER MAINTENANCE *Specify* **KEARNEY PRODUCTS**

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SALES ASSIGNMENTS

COMPANY STAFFS

Allis-Chalmers Manuacturing Co's Industries Group has announced the following assignments to Western sales posts: James C. Barnett, to the Dallas district office; Hugh T. Coplen, Phoenix district office; Dale Stephenson, power plant equipment representative, Southwest region; and Theodore E. Meyers, Portland district.

Bakelite Co has named F. W. Wurtzell as central zone manager for the Extrusion Materials Division. With offices in Chicago, he will supervise district sales offices in Chicago, Detroit, Cleveland, and Cincinnati.

Bishop Manufacturing Corp has designated James Kelso, Jr, to represent the firm in all the New England states. He will operate from the new Boston office.

Curtis Lighting, Inc, has named the following three regional sales managers: Frank J. Bernd, Chicago; Fred A. Stewart, Eastern; and Earl I. Dinsmore, Southwestern.

Gould-National Batteries, Inc, has appointed Richard Relf as Detroit regional sales manager of the Industrial Division.

Graybar Electric Co has made the following appointments: C. R. Downing, Jr, to Tulsa manager; F. L. Cummings to Denver manager; K. H. Coyner to operating manager at Norfolk; E. H. Helms to operating manager at Asheville; F. D. Masten, operating manager at Durham; and J. H. Gordon, Jr, to supervisor of the Santa Ana sub-branch in the Los Angeles territory.

I-T-E Circuit Breaker Co's Joseph W. Ferral has joined the Kelman Electric & Manufacturing Co (West Coast subsidiary) as field application engineer to cover the Los Angeles and Southern California area . . . E. W. Atherton is new manager of I-T-E's Houston, Texas, district office.

Line Material Industries has named Russell W. Crick and Edward R. Mongoven field engineers. Crick will handle L-M sales in western North Carolina and northwestern South Carolina, with offices in Charlotte, N. C. Mongoven will cover western New York, with headquarters in Buffalo.

McGraw-Edison Co's Pennsylvania Transformer Division has named Roy E. Coulson as sales representative in Arizona.

Nordberg Manufacturing Co has designated Richard C. Gamble as district manager of the St. Louis area, which includes eastern Missouri, southern Iowa, and the state of Illinois.

Ohio Brass Co has appointed Vernon L. Crabb as Los Angeles district manager

to succeed Raymond F. Gheen upon the latter's retirement on Jan. 1, 1958. James R. Hays replaces Crabb as district manager of the southern Ohio, Indiana, and Kentucky territory.

Riley Stoker Corp's three new sales engineers are James B. Ragan, Jr, who will be located at the Worcester, Mass., office; John V. Morowski, Chicago office; and Robert C. Meleney, Philadelphia.

Southern States Equipment Corp has named Les Strahl as district representative in the new field office in Prairie Village, Kans. He will cover the north central states.

Thor Power Tool Co has promoted James P. Stine to manager of the New York branch.

Westinghouse Electric Corp's northeastern apparatus sales region has named H. E. Dralle as assistant to the regional vice president. In other regional appointments, E. C. Horton was named New York City district manager; J. L. Steffenhagen, Connecticut Valley district manager; and L. H. Rollins, branch manager, Bridgeport (Conn.) office. . . Edward E. Lacy was recently advanced to Pacific Coast manager of machinery electrification. . . The appliance sales component has named John W. Vogt as manager of sales administration. . . Ray E. Nowels is new operating and accounting administrator at the appliance sales headquarters office in Pittsburgh. . . Bryant Electric Co, a subsidiary, has appointed Clyde W. Foster Midwest regional manager.

REPRESENTATIVES

Automatic Switch Co has appointed Morristown (N. J.) Electrical Supply Co as authorized stocking distributors of Asco solenoid valves in the area . . . Terco Equipment Co will perform similar duties in the San Francisco, Calif., territory.

Clifton Conduit Corp, a subsidiary of General Cable Corp, has named the following representatives: J. J. Costello of Boston, for the states of Maine, New Hampshire, Vermont, Massachuetts, and Rhode Island; J. R. Shafnacker of Ridgewood, N. J., for northern New Jersey; Bill Crichton & Associates of Riverview, Fla., for most of Florida; Charles L. Woodyard & Associates of Atlanta, for Georgia and Alabama, exclusive of Mobile; Monitor Sales Co of Detroit, for Michigan; and Henger-Fairfield Co of Cleveland, for Ohio.

Cornell-Dubilier Electric Corp has appointed Frank Abbett and Walter Hustis as sales representatives in the New England area.

Worthington Corp has appointed A. E. Borden Co as packaged air conditioning equipment wholesaler for Maine, New Hampshire, Rhode Island, and eastern Massachusetts. Wilder Parks will serve as Borden sales manager for Worthington equipment.

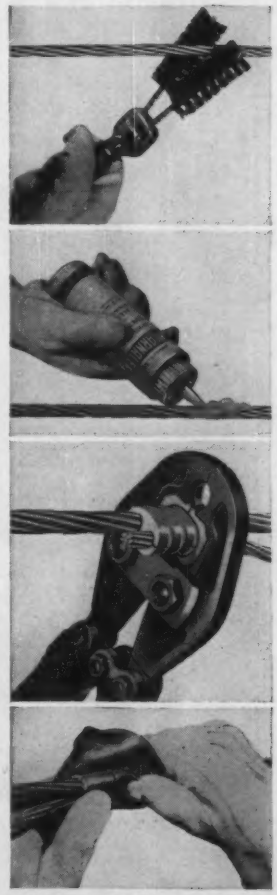
KEARNEY AIRSEAL

and these 4 simple steps

give you

Better Electrical Connections...

trouble-free service for years to come!



CLEAN conductor contact surfaces with Kearney Cleaning Brush to completely remove oxides and foreign matter from between strands. Cleans two sides of conductor at once, in half the time. There are Kearney Brushes for hand and hot-stick use.

PROTECT cleaned contact surfaces with Kearnalex Corrosion Inhibitor. Non-hardening, non-flowing, greaseless paste . . . seals out oxidizing agents and moisture. Will not harm hands or rubber gloves; washes out of clothing. In cans or tubes.

SELECT the right Kearney Squeezon Connector for the size and type of conductors, and the kind of connection being made. Then select installation tool best suited to apply connector, and the proper die. There is a Squeezon Connector for every distribution line connection, and easy-to-use Kearney tools for cold or hot-line work.

SEAL—and permanently protect high initial conductivity of finished connection—with Kearney Airseal. Pliable, non-hardening, easily molded; doesn't stick to gloves or hands. *Seals out* air and moisture—especially good for blocking galvanic action in bi-metallic connections, or those operating in corrosive atmosphere. In pads or rolls.

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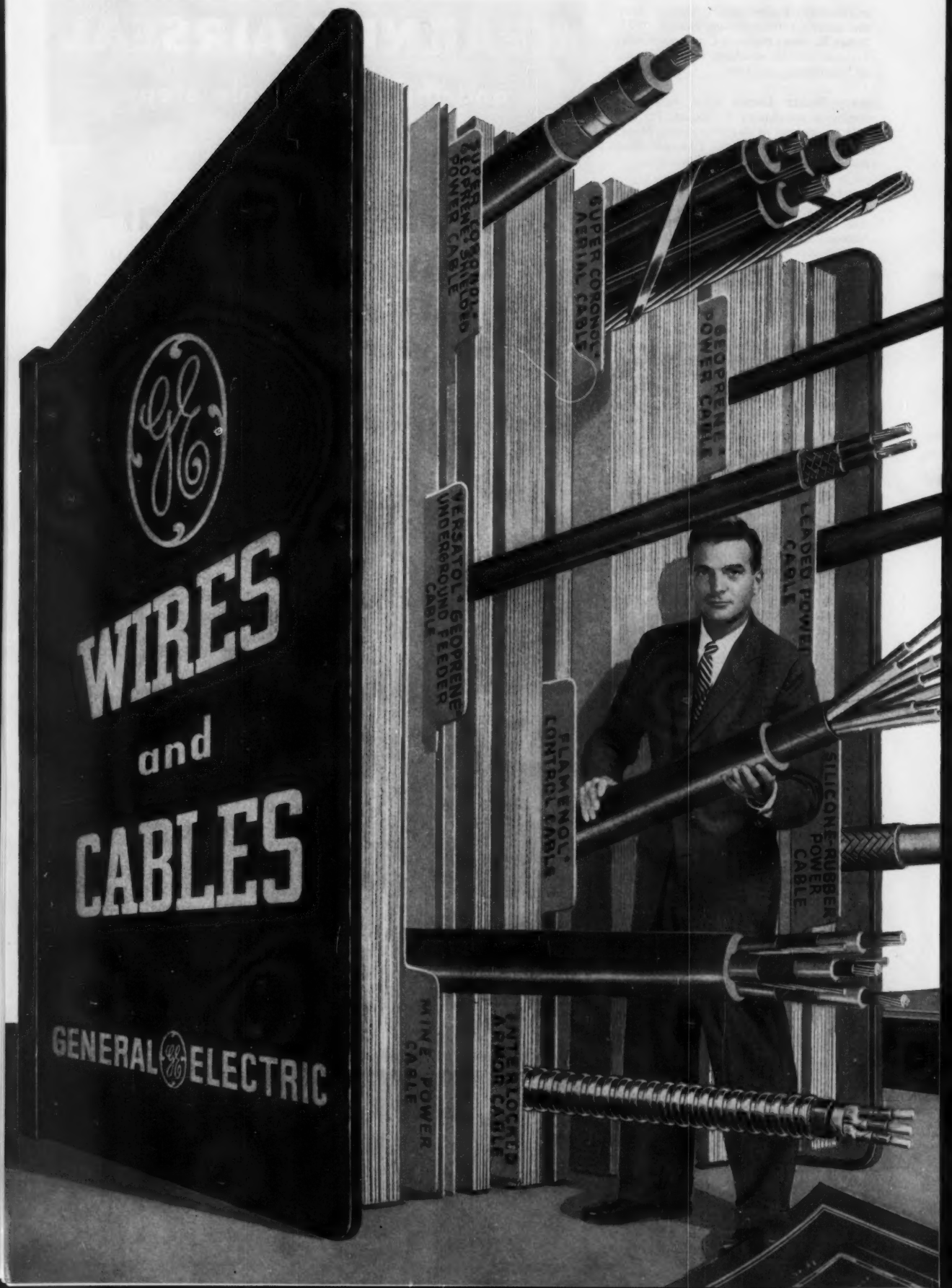
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and
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catalogs full of cables... but

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The problem of selection is one of the important reasons why many electric utilities and industrial plants work with General Electric wire and cable engineers in planning their electrical expansion and modernization programs.

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General Electric's knowledge of the requirements of other basic components of power distribution systems—transformers, load centers, switchgear, etc.—has led to the conviction that the right cable plays an important part in satisfactory system performance.

As a result, General Electric has developed hundreds of cables for just about every possible application. Thus, G-E engineers are not limited to one wire or cable for a given job but can suggest the most efficient and economical solution for the particular situation.

All this adds up to experience that can benefit you. Take advantage of it the next time you have a cable selection problem. For information on your specific wire and cable application or selection problem, see the G-E wire and cable specialist in your locality or write Section W201-1027, Wire and Cable Department, General Electric Company, Bridgeport 2, Connecticut.

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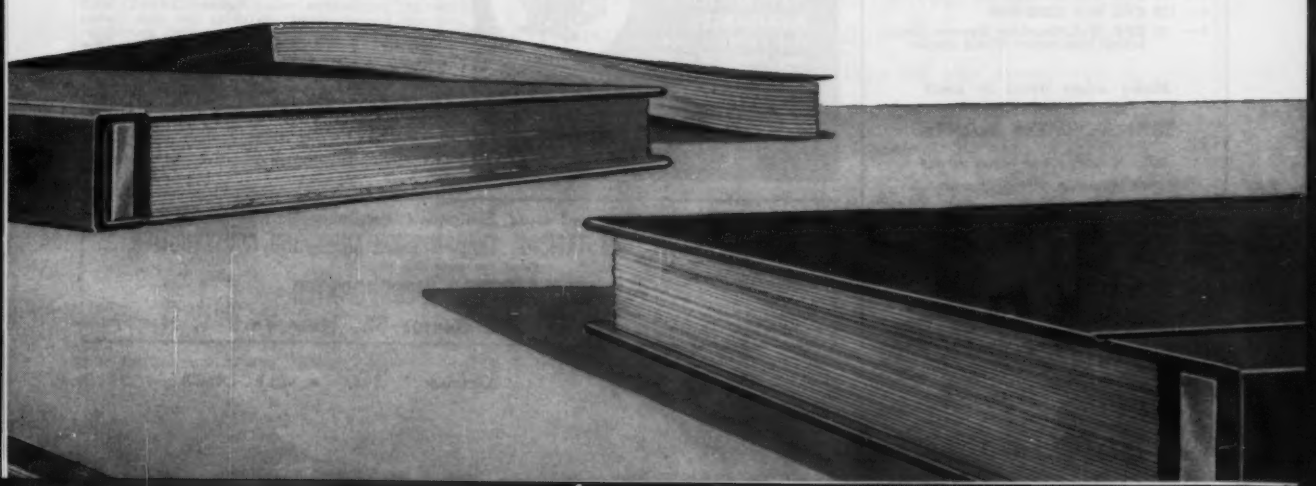

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3— 500 KVA G-E 22000-2300/4000Y
3— 500 KVA G-E 2400/4160Y—240x480
3— 333 KVA Mol 2300—230x460
3— 333 KVA Penn 2400—240/480
3— 250 KVA W-H 22000-7200/12470Y
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Many other items in stock

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Reliable rewind and repair service on all makes of transformers

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Special low prices.
Write, wire or phone collect!
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U. S. Government

Bids: Nov. 15, 1957.

Sealed bids will be received in the office of the Engineering and Construction Director, Panama Canal Company, Balboa Heights, Canal Zone, until 1:00 P.M. November 15, 1957 and at that time publicly opened, for the material and work required to furnish and install a coordinated system of remote supervisory control, telemetering equipment, protective relaying equipment, and other appurtenant material for the Canal Zone power facilities. Plans and specifications are available for examination in the office of Chief, Procurement Division, Panama Canal Co., 21 West St., New York 6, N. Y. Data may be obtained upon payment of $50.00 deposit which will be refunded when data is returned within 40 calendar days after bid opening. For further information contact this office, Desk No. 1, or telephone Bowling Green 9-5380, extension 56.

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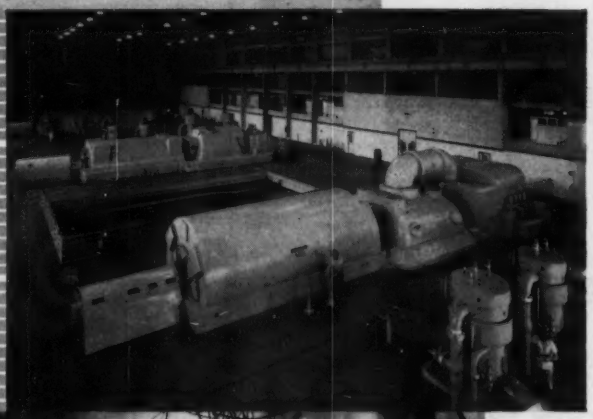

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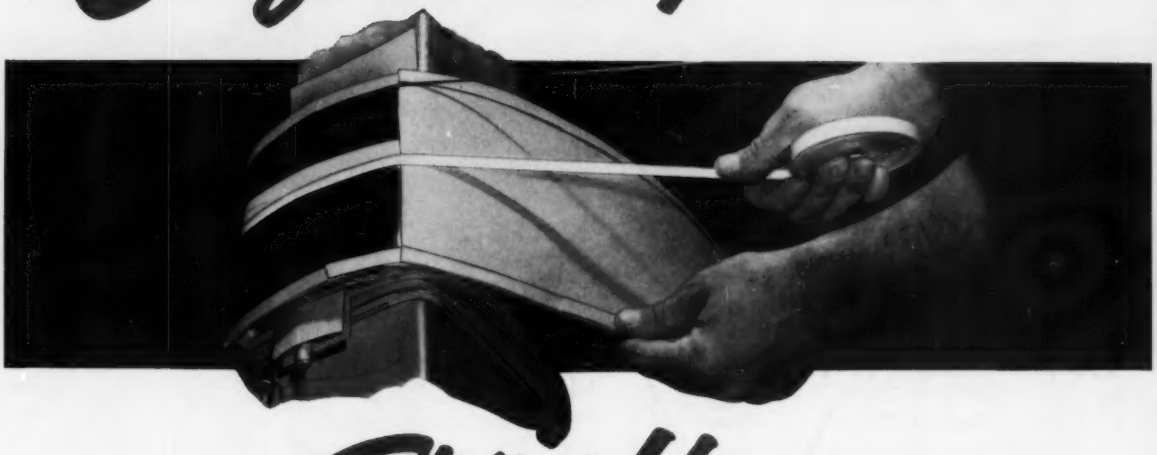

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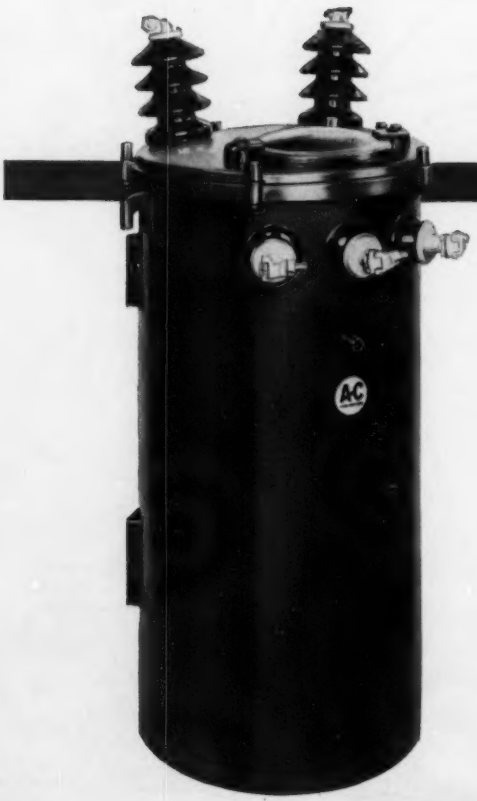

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